MINI COLOR SERIES 7519

Iraq Insurgency

U.S. Army Armored Vehicles in Action (Part 2)

Carl Schulze

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Abbreviations

ACADA	Automatic Chemical Agent Detection Assembly
ACAV	Armored Cavalry Assault Vehicle
AIM	Abrams Integrated Management
APC	Armored Personnel Carrier
ASIP	Advanced System Improvement Program
ATGM	Anti-Tank Guided Missile
AVLB	Armored Vehicle-Launched Bridge
CITV	Commander's Independent Thermal Viewer
C-HET	Commercial Heavy Equipment Transporter
CONUS	Continental United States
CPK	Crew Protection Kit
CROP	Container Roll-in/Out Platform
CROWS	Common Remotely Operated Weapon Station
CTIS	Central Tire Inflation System
DAGR	Defense Advanced GPS Receiver
DVE	Driver's Vision Enhancer
ECM	Electronic Counter-Measure
EOD	Explosive Ordnance Disposal
EPLRS	Enhanced Position Location Reporting System
ETM	Embedded Training Module
ETS	Elevated TOW System
FAASV	Field Artillery Ammunition Supply Vehicle
FBCB2	Force XXI Battle Command, Brigade-and-Below
FIST	Fire Support Team
FMTV	Family of Medium Tactical Vehicles
FSV	Fire Support Vehicle
FTSS	Fuel Tank Self-Sealing System
GPS	Global Positioning System
HA	Heavy Armor
HC	Heavy Common
HEMTT	Heavy Expanded Mobility Tactical Truck
HERCULES	Heavy Equipment Recovery Combat Utility Lift and Evacuation System
HETS	Heavy Equipment Transporter System
HHC	Headquarters and Headquarters Company
HMMWV	High Mobility Multipurpose Wheeled Vehicle
IAV	Interim Armored Vehicle
ICV	Infantry Carrier Vehicle
IED	Improvised Explosive Device
JCIMS	Joint Combat Identification Marking System
JERRV	Joint EOD Rapid Response Vehicle
LHS	Load Handling System
LMTV	Light Medium Tactical Vehicle
LRAS3	Long Range Advanced Scout Surveillance System
LSAC	Low Signature Armored Cab
MBT	Main Battle Tank
MC	Mortar Carrier
MCB	Mine Clearing Blade
MGS	Mobile Gun System
MICAD/A	Multipurpose Integrated Chemical Agent Detector/Alarm
MSR	Main Supply Route
MITAS	Modified Improved Target Acquisition System
MRAP	Mine Resistant Ambush Protected
MTV	Medium Tactical Vehicle
NBC	Nuclear, Biological, Chemical
NBCRS	Nuclear, Biological, Chemical Reconnaissance System
OIF	Operation Iraqi Freedom
PCMCIA	Personal Computer Memory Card International Association
PLGR	Precision Lightweight GPS Receiver
PLST	Palletized Load System Trailer
RMS6-L	Recoiling Mortar System 6-L
RPG	Rutschnoi Protiwotankowij Granatomjot – Rocket-Propelled Grenade
RSCAAL	Remote Sensing Chemical Agent Alarm
RV	Reconnaissance Vehicle
SBCT	Stryker Brigade Combat Team
SEP	System Enhancement Program
SINCGARS	Single Channel Ground and Airborne Radio Systems
SAW	Squad Automatic Weapon
STORM	Small Tactical Optical Rifle Mounted
SVBIED	Suicide Vehicle-Borne Improvised Explosive Device
TAGS	Transparent Armor Gun Shield
TOW	Tube-launched, Optical-tracked, Wire-command-link-guided
TUSK	Tank Urban Survival Kit
USMC	United States Marine Corps
VBIED	Vehicle-Borne Improvised Explosive Device
WMD	Weapon of Mass Destruction

Introduction

January 2008: Two years have passed since the first volume of the two-part work, "Iraq Insurgency: U.S. Army Armored Vehicles in Action", has been published. Still the struggle for peace in Iraq has not come to an end, and the number of U.S. troops killed in Iraq has risen to some 3960. In addition 29,000 U.S. personnel have been wounded in combat operations.

But U.S., Coalition and Iraqi Security Forces (ISF) have not been the only ones targeted. In 2006, sectarian violence between Shiites and Sunnis escalated further. On 22 February 2006, the gold-covered dome of the holy Al-Askari Mosque in Samarra was destroyed in an attack. In November 2006, one of the deadliest bombings since the beginning of the insurgency caused the deaths of more than 200 people in Sadr City, Baghdad. In the incident, five car bombs were detonated on crowded streets. All over Iraq, areas populated by a mixture of Sunnis and Shiites erupted in violence aimed at terminating minorities so as to let one or the other side gain power in the region. In Baghdad, warring factions were fighting for power in most districts. Even the presence of U.S. and ISF troops did not stop "death squads" from raiding houses of opposing ethnicities and slaughtering inhabitants.

In the USA, in the meantime, the growing number of American troops killed and the skyrocketing cost of involvement in Iraq have resulted in a series of political clashes between the Bush administration and the political opposition. In November 2006, Congress elections resulted in a victory for the Democratic Party. One could say this was partly the effect of the Iraq War launched by President Bush becoming more and more unpopular with citizens. In what looked like a last attempt at solving the Iraq problem and finally terminating the Iraq insurgency, the government launched a series of initiatives.

As the first step, General David Howell Petraeus was assigned as new Commanding General Multinational Forces – Iraq on 26 January 2007, replacing General George Casey. In addition, a massive increase in U.S. troop levels, called the "Surge", was announced by President Bush on 10 January 2007. In late 2006/early 2007, some 132,000 U.S. troops were officially operating in Iraq, not including Special Forces. Another 30,000 were supporting operations in Iraq from bases elsewhere in the theater. Originally it was announced this number would be increased by some 21,500 troops, the equivalent of five combat brigades. The plan was to deploy these brigades to Baghdad to end the bloodshed and sectarian violence. By June 2007, U.S. Armed Forces declared that all troops earmarked for the "Surge" had been deployed. By then the number of additional deployed troops had risen from the original 21,500 to 28,000. The total grew further and reached a peak in September 2007, when some 168,000 U.S. troops were operating in Iraq, supported by an additional 30,000 soldiers elsewhere in the region.

As a result of the "Surge" and the massive presence of U.S. and Coalition forces on the streets of Iraq, the number of incidents such as IED attacks, bombings of civilian markets and ethnic cleansing dropped significantly. On the other hand, the deadliest single attack of the whole war occurred during the "Surge". Some 500 people were killed by a series of coordinated suicide bomb attacks on the northern Iraqi village of Qahtaniya in August 2007. By December 2007, U.S. Armed Force numbers began reducing in Iraq. At the same time they launched a series of major operations against insurgents and Al-Qaeda terrorists all over Iraq. At the time of writing it is hard to say whether the "Surge" has had the effect hoped for, and whether the insurgency is actually winding down. One thing is sure though, Iraq is still a long way from becoming a peaceful, democratic country.

Countering the IED Threat

The weapon of choice for insurgents in Iraq is the Improvised Explosive Device (IED). At least 1700 of the U.S. troops killed in Iraq have been victims of IEDs. In order to counter this threat, the U.S. Army initiated the Vehicle Hardening Program in October 2003, as described in Part 1 of this work. By 2007, all trucks operated by the U.S. Armed Forces in Iraq had been fitted with Level I and Level II armor as a result of this program. In addition, the military also introduced new HMMWVs (M1151P1/A1, M1152P1/A1 and M1165P1/A1 Expanded Capacity Vehicles) that feature built-in armor suites and can be fitted with modular armor packages. In order to further improve the armor of vehicles, M1114 Up-armored HMMWVs and newly introduced HMMWVs were fitted with additional add-on armor packages known as FRAG Kits. So far, FRAG 3, FRAG 4, FRAG 5 and FRAG 6 have been fielded. FRAG Kits include new doors and armor panels mounted onto the original armor of vehicles. In addition to these measures, the USA has also fielded several different Electronic Countermeasure (ECM) systems to jam radio remote-control systems used by insurgents to trigger IEDs.

Mine Resistant Ambush Protected

In parallel to the measures listed above, the Department of Defense (DoD) initiated the Mine Resistant Ambush Protected (MRAP) Vehicle Program under which a range of totally new vehicles types were procured. MRAPs are heavily armored vehicles purpose-designed to withstand mine and IED blasts, and to provide crews with the highest possible level of protection. Although the first vehicles procured under the MRAP program entered service in 2004, the MRAP Vehicle Program was not fully initiated until 2006. Due to the fact that the U.S. Marine Corps (USMC) had already procured large numbers of MRAPs, USMC System Command at Quantico was eventually tasked with overseeing contract activities for all services of the U.S. Armed Forces. According to their mission, troop capacity, weight and size, MRAPs are placed in three categories. The DoD lists these as follows:

Category I MRAPs, also known as the Mine Resistant Utility Vehicle, are typically 4x4 vehicles carrying a crew of two and four passengers. They are smaller and lighter than MRAPs in the other two classes, and are designed for urban operations. Category I MRAPs are the RG-31, RG-33, Cougar 4x4 and MaxxPro MPV.

Category II MRAPs are large, typically 6x6 vehicles, with a greater payload than Category I. They have a larger troop compartment in which eight or more troops can be transported in addition to a two-man crew. Vehicles are designed as troop transports, convoy escort vehicles, engineer vehicles or ambulances. A special version of the MRAP Category II is the Joint Explosive Ordnance Disposal Rapid Response Vehicle (JERRV). Category II MRAPs are the Cougar 6x6, RG-33L and MaxxPro XL.

Category III MRAPs are IED- and mine-clearance vehicles. Due to the special mission assigned to these vehicles, they are the largest and heaviest. So far only the Buffalo has been procured in this category.

It is believed that, in addition to the types of vehicles just mentioned, other types from other manufacturers might also be procured in the near future. Only in 2007 did the DoD order production of about 10,000 MRAPs at a cost of USD5.2 billion. There are future plans for the MRAP fleet to eventually replace the HMMWV as a patrol vehicle in frontline service. The U.S. military has announced a total requirement of more than 20,000 MRAP vehicles, of which 17,700 are earmarked for the U.S. Army and some 3400 for the USMC.

About this book

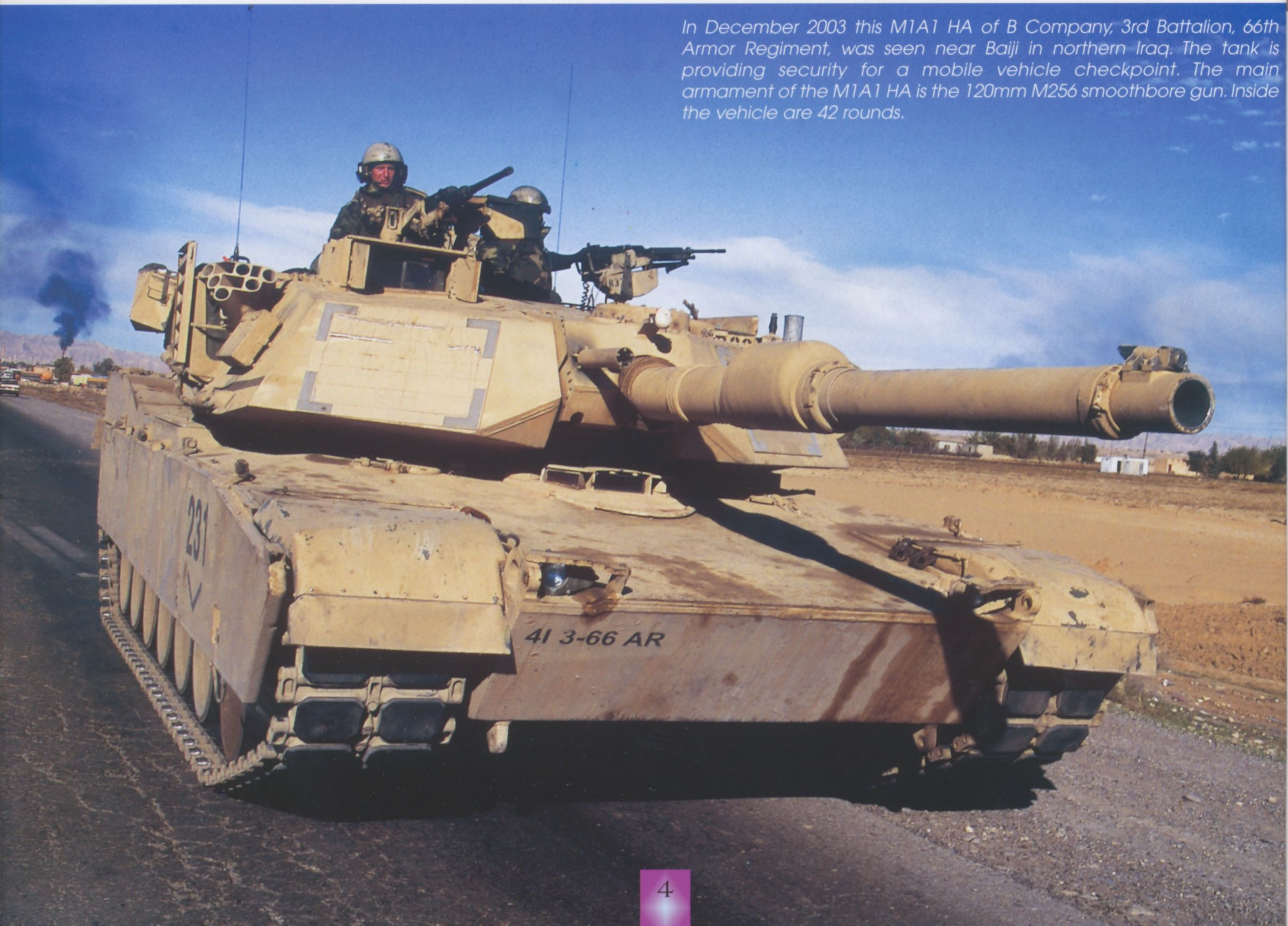
Although we have already covered some MRAP vehicle types in Part 1, in this volume we will look at some more, namely the Cougar 4x4 and 6x6, plus the RG-33L. We will also cover the Stryker Interim Armored Vehicle family that had its combat debut in December 2003, and we will take a look at Crew Protection Kits procured under the Vehicle Hardening Program for the Heavy Equipment Transporter System, the family of Heavy Expanded Mobility Tactical Trucks, and the Family of Medium Tactical Vehicles. Other armored vehicles covered in this volume are the M1 Abrams Main Battle Tank (MBT), M109A6 Paladin self-propelled howitzer, M93A1 Fox Nuclear, Biological, Chemical Reconnaissance System, M88A1 Armored Recovery Vehicle and M88A2 HERCULES. For further reading we suggest you also consult the following three Concord Mini Color Series titles written by the same author: Iraq Insurgency: U.S. Armored Vehicles in Action (Part 1) (Number 7518), Stryker Interim Armored Vehicle (Number 7515) and U.S. Army HMMWVs in Iraq (Number 7513).

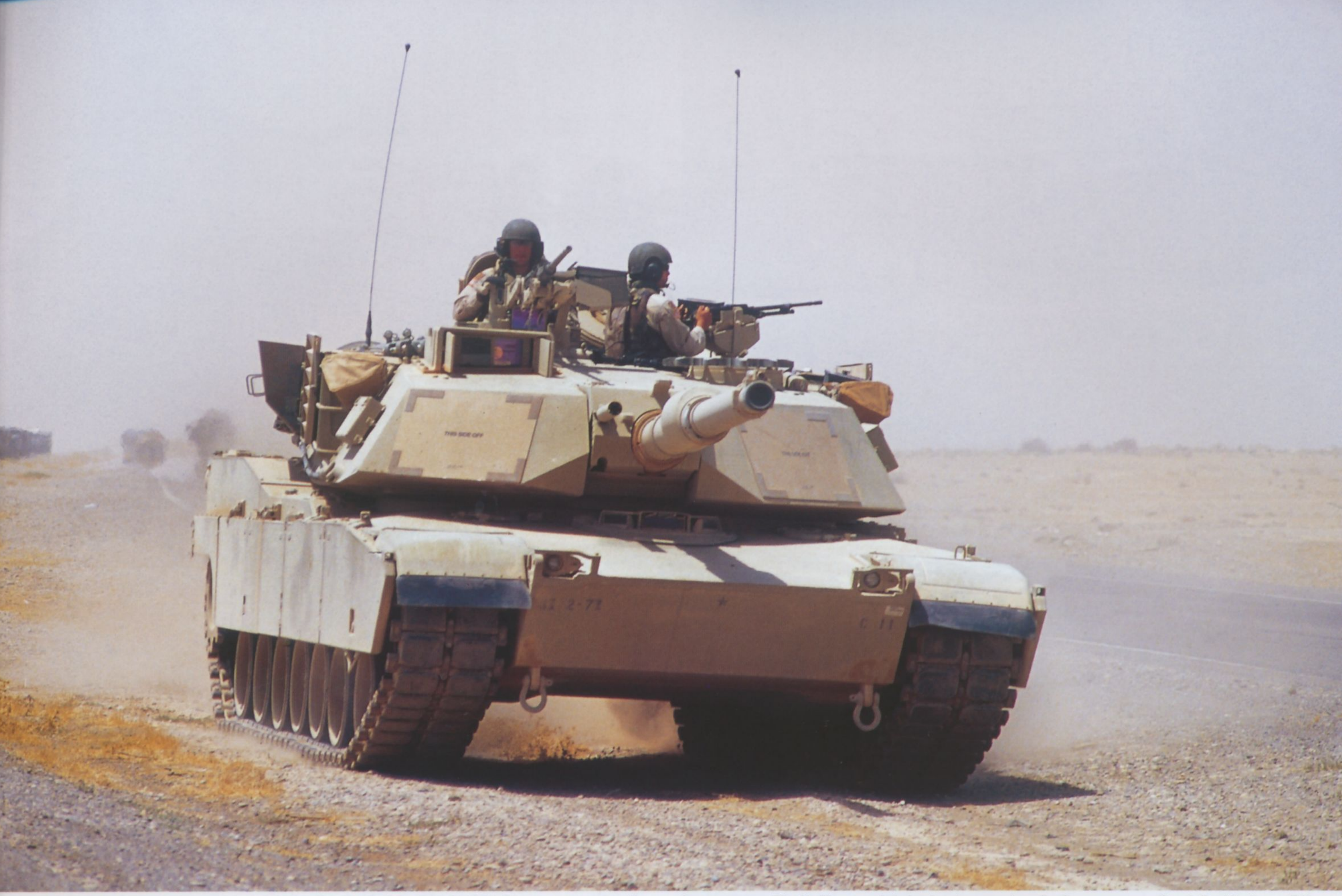
The M1 Abrams MBT is the main weapon system of armor units in the U.S. Army, Army National Guard (ANG) and USMC. Currently the M1 Abrams tank is the only MBT in service with the U.S. Armed Forces, having replaced the M48 and M60. The tank is named after General Creighton Williams Abrams. During WWII, Abrams was a tank battalion commander, and later as a general he was commander of U.S. forces in Vietnam 1968-72. The first M1 MBTs were fielded in the early 1980s, initially fitted with a 105mm M68A1 rifled tank gun. In 1985 the M1A1 began entering army service featuring a 120mm M256 smoothbore tank gun developed by Rheinmetall in Germany, which greatly increased the tank's firepower. The survivability of the M1A1 was also improved as it was fitted with an improved armor package on the hull and turret front, as well as an NBC overpressure system. Between 1985 and 1988, a total of 2388 M1A1 MBTs were manufactured for the U.S. military. In subsequent years the M1A1 HA (Heavy Armor) and M1A1 HA+ were produced. Both M1A1 variants feature spaced ceramic armor backed by a steel-encased depleted-uranium mesh. A total of 2164 M1A1 HA and M1A1 HA+ were manufactured between 1988 and 1993. M1A1s produced from 1990 onwards also featured engineering changes designed to fulfill USMC requirements such as provision of a deep-water fording kit. These vehicles bear the designation M1A1 Heavy Common (HC) and were fielded by both the USMC and army. The USMC had earlier decided to replace its aging fleet of M60A1 MBTs with the M1A1 Abrams, and according to USMC sources, the first Abrams tanks entered Marine service as early as November 1990.

1991 Gulf War

Originally designed to dominate the European battlefield in a possible war between NATO and the Soviet-led Warsaw Pact by destroying waves of attacking enemy tanks, the Abrams never saw action in such a scenario. Instead, M1A1 Abrams variants had their combat debut in the 1991Gulf War. Some 1850 M1, IPM1, M1A1, M1A1 HA and M1A1 HA+ tanks took part in the 100-hour ground offensive named Operation Desert Saber that was aimed at liberating Kuwait. During engagements, M1 tanks proved superior to the older Russian-designed T-55 and T-62 tanks employed by Iraqi Army units, as well as against newer T-72 tanks. With a combat range exceeding 2500m, the M1A1 could defeat Iraqi armor well before getting within range of the enemy. It is therefore no wonder that M1 tanks destroyed more than 2000 enemy tanks and armored fighting vehicles while U.S. tank losses were minor. The armor of the M1A1, based on British Chobham armor, also proved itself. In at least one case an M1A1 was hit on its frontal armor by a 125mm KE round from an Iraqi T-72, though the round did not penetrate. During the fighting, only 18 M1 and M1A1 tanks were damaged beyond repair. Unfortunately, several of these were damaged by friendly fire. According to unofficial sources, only one tank crewmember was killed in these incidents, though several were wounded.

After the 1991 Gulf War, M1A1 tank variants saw action in Somalia in 1992-93, in Bosnia from 1996 onwards, and in Kosovo from 1999 onwards. Also in 1999, the U.S. Army launched the Abrams Integrated Management (AIM) program. Under this program, aging M1A1 tanks were recapitalized to an as-new condition. They were standardized by changing primary parts used in differing versions to a common design, and they were modernized by integrating the latest technology. Since 2000, some 90 tanks have been run through the AIM program annually, though the number was recently increased to 135.


In December 2003 this M1A1 HA of B Company, 3rd Battalion, 66th Armor Regiment, was seen near Baiji in northern Iraq. The tank is providing security for a mobile vehicle checkpoint. The main armament of the M1A1 HA is the 120mm M256 smoothbore gun. Inside the vehicle are 42 rounds.



An M1A1 HC patrols along Main Supply Route (MSR) Tampa in northern Iraq near Tikrit. The vehicle belongs to C Company, 2nd Battalion, 7th Infantry Regiment, and was seen in August 2005. After the initial invasion, MBTs were only used occasionally as offensive weapons. Most of the time, tanks were used to patrol hostile areas and protect mobile and static vehicle checkpoints. By virtue of their state-of-the-art thermal sights, tanks were also used extensively for surveillance missions.

M1A2 and M1A2 SEP

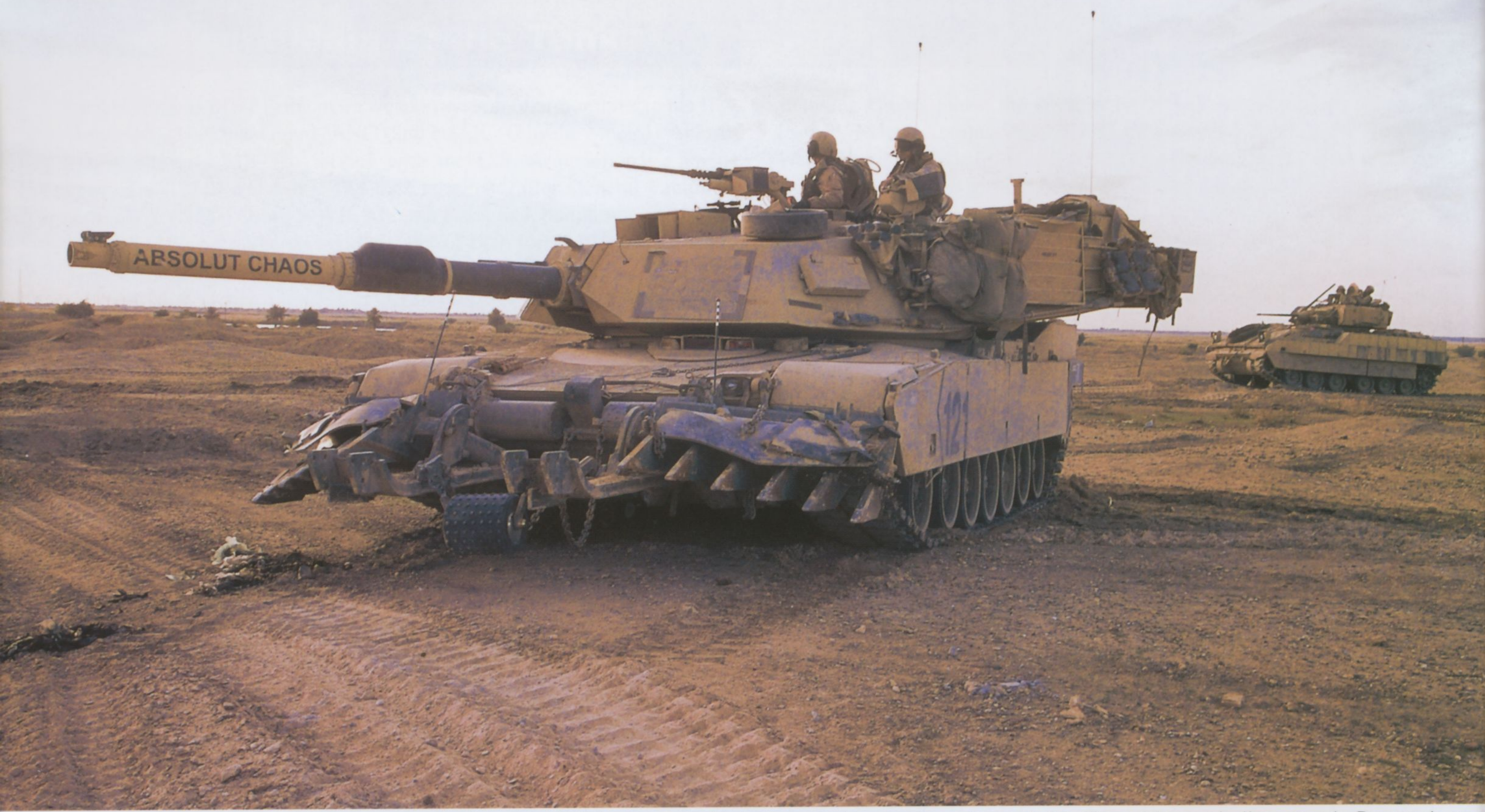
Development of the M1A2 started right after production of the M1A1 began, with the aim of further improving the tank's capabilities. In 1988 General Dynamics Land Systems (GDLS) received a development contract, and the first M1A2 prototypes were delivered in 1992. Low Rate Initial Production (LRIP) of 62 new M1A2s commenced the same year. As production costs had skyrocketed and available funds were limited, it was decided to convert old M1 tanks to M1A2 standard rather than to build new vehicles. Between 1994 and 2001, some 566 M1A2s were produced. The M1A2 features a digital Inter-Vehicular Information System (IVIS), Commander's Independent Thermal Viewer (CITV), Improved Commander's Weapon Station, Navigation/Position (NAV/POS) equipment, and an Auxiliary Power Unit (APU) mounted in the turret basket.

The CITV provided tank crews with a "hunter-killer" capability that made target acquisition 45% faster, and target handoff from commander to gunner 50-70% faster. The M1A2 also featured a digital Command, Control and Communication (C^2) suite called Inter-Vehicular Information System, which improved the crew's situational awareness on the battlefield, as well as their ability to react to changing tactical situations. At the same time, after entering the coordinates of a starting position into the NAV/POS internal navigation system, it allowed the crew to quickly locate their current position by measuring the distance the tank had moved. Fielding of the M1A2 Abrams MBT took place in the late 1990s, and the first armor units to be issued with the new tank belonged to the 1st Cavalry Division at Ford Hood, Texas.

In order to speed up digitalization of the army's MBT fleet, M1A1s were fitted with a digital appliqué command and control (C^2) system similar to that of the M1A2 under a separate program. Tanks modified in this way were given the designation M1A1D, but only some 100 were converted. While it was revolutionary, the digital C^2 suite of the M1A2 and M1A1D proved difficult to operate, and NAV/POS was not accurate enough and too vulnerable to human error. Development work aimed at solving these problems and improving the M1A2 started under a System Enhancement Program in 1994. The work resulted in the most modern version of the Abrams MBT, the M1A2 SEP. Among other improvements, the M1A2 SEP features an Integrated Power/Cooling/Environmental System, improved displays (16:9 color flat panel), Mass Memory Unit, Under-Armor APU, II-Generation Thermal Imaging System, Improved Soldier Machine Interface (voice synthesis, loader's remote display, PCMCIA interface), Tactical Communication Interface Module, PLGR (replaced by EPLRS), SINCGARS ASIP radios, and FBCB2/Blue Force Tracker. Conversion of older M1A1 Abrams variants, along with M1A2s to M1A2 SEP standard, began in 2001. The last order to convert vehicles to M1A2 SEP standard was placed in November 2007. Once this order is delivered, the army fleet will consist of some 1100 M1A2 SEP tanks.

Operation Iraqi Freedom

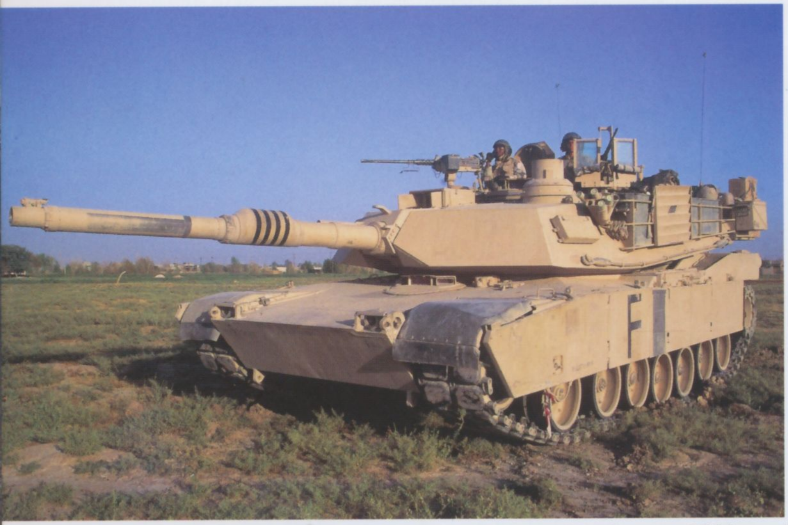
Like the 1991 Gulf War, the Abrams MBT performed well in the U.S. invasion of Iraq in 2003. According to an official U.S. Army Lessons Learned Report, the M1 tank provided excellent maneuverability, superior firepower and excellent overall crew protection. As a result, Iraqi armor was again easy prey for U.S. tanks. At the beginning of the invasion, the army and USMC had deployed some 350 M1 Abrams to the theater. This number was increased by the arrival of some 200 additional tanks belonging to reinforcements after the invasion kicked off. The bulk of the deployed fleet were M1A1 variants (HA, HA+, AIM), but M1A2 and M1A2 SEP also saw action during engagements with the Iraqi Army. Compared to the number of M1 Abrams deployed, the number of combat losses was extremely low, with only 14 tanks lost. None of these losses



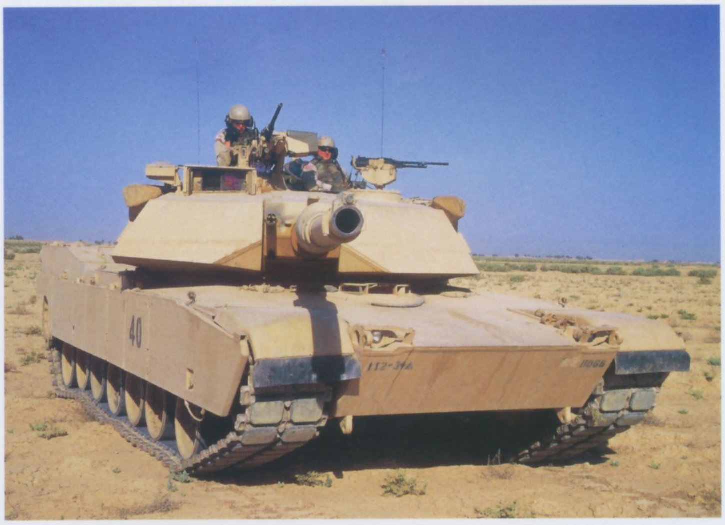
After an insurgent attack on a convoy in Samarra, U.S. forces conducted several operations to crush hostile resistance in the area in December 2003. Here an M1A1 HA Abrams fitted with an MCBS can be seen operating in the ruins of the medieval caliphate city just north of the modern city. The vehicle belongs to A Company, 1st Battalion, 68th Armor Regiment. Note the nickname "Absolute Chaos" painted on the barrel of 120mm M256 smoothbore gun.

were catastrophic kills, but in most cases enemy fire caused a mobility kill or fire in the engine compartment that then led to the final destruction of the tank. Other tanks were lost to mechanical failures, and where recovery was not possible they were destroyed by crews to prevent technology from falling into enemy hands.

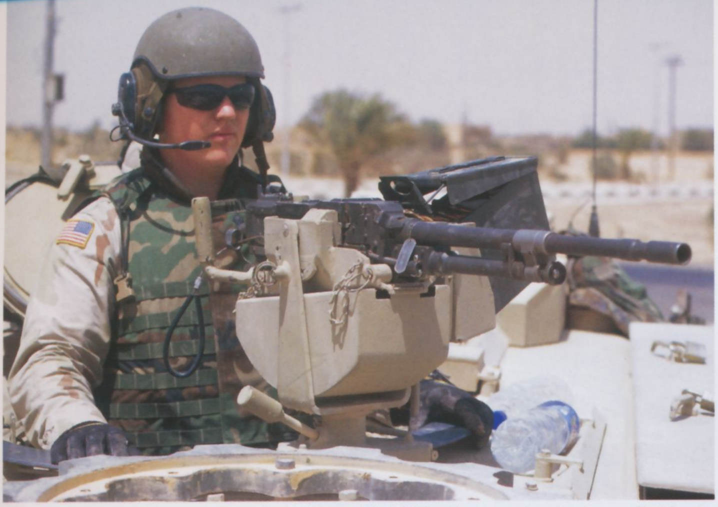
While the M1 was used as an offensive weapon in the initial invasion, this changed when Operation Iraqi Freedom (OIF) became a guerilla war. Tanks were then employed at checkpoints to protect deployed troops, and used at mobile checkpoints and for patrolling dangerous territory where IED attacks regularly occurred. In addition, tanks were deployed every time heavy firepower was required, for example during the second Battle of Fallujah in April 2004 (Operation Phantom Fury) or the Battle for Najaf in August 2004. Often such deployments forced crews to operate tanks in urban areas where they were vulnerable to enemy attack. Tanks are heavily armored on their frontal arc, but the sides, rear and top usually feature less armor protection. On the open battlefield, a tank defeats the enemy by engaging them before coming within range of enemy antitank weapons. The capability to destroy an enemy at long range and to use speed and maneuverability to avoid engagement by the enemy are paramount, but a



Some 566 M1A2 Abrams MBTs were produced between 1994 and 2001. Of these, 123 entered service with the 3rd Armored Cavalry Regiment and subsequently saw action with the unit in Iraq in OIF I (March 2003 - April 2004) and then again in OIF III (March 2005 - March 2006). In the summer of 2006, the regiment exchanged its M1A2s for the newer M1A2 SEP. Here an M1A2 of Fox Troop, 2nd Squadron, 3rd Armored Cavalry Regiment, is seen near Tall Afar in the summer of 2005.



In 2005 this M1A1 AIM was seen south of Baqubah. The vehicle belongs to the 2nd Battalion, 34th Armor Regiment. Under the AIM program, aging M1A1 tanks were recapitalized to as-new conditions. While one main aim of the AIM program was standardization, this was not achieved as newer upgrades entered the program over the years, resulting in early M1A1 AIMs differing from later ones in many ways. It is believed that in some cases tanks that have seen a lot of service have already been through the program twice.



The secondary armament of the M1A1 HC Abrams includes a 7.62mm M240 coaxial machinegun, 7.62mm M240 loader's machinegun and 12.7mm M2 machinegun for the commander. Here the loader's weapon on a tank from the 2nd Battalion, 7th Infantry Regiment, can be seen.

tank crew does not have this capability in an urban environment where fighting takes place at close range and in limited space. In addition, built-up areas offer the enemy thousands of places to hide, as well as ways to sneak up close to tanks to use handheld antitank weapons at close range.

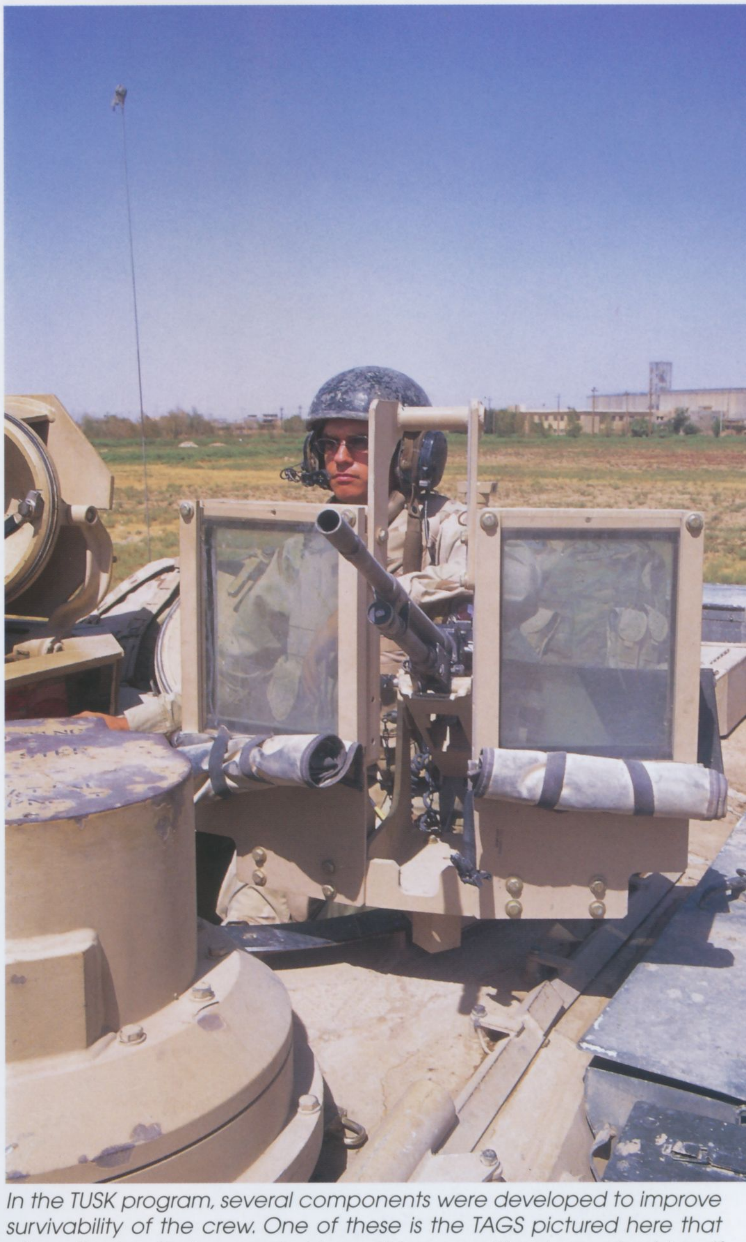
By 2005 the number of Abrams badly damaged by enemy action had risen to around 80. Most of these were damaged by IEDs or handheld antitank weapons such as the RPG-7. Usually tanks were taken out from the sides, from above or from the rear. In one case an M1 was destroyed by a massive IED buried under a dirt road. The blast was so large that the turret of the tank was blown off the hull. At least five crewmembers had died inside Abrams tanks as a result of enemy attacks up till 2005.

Modifications and TUSK

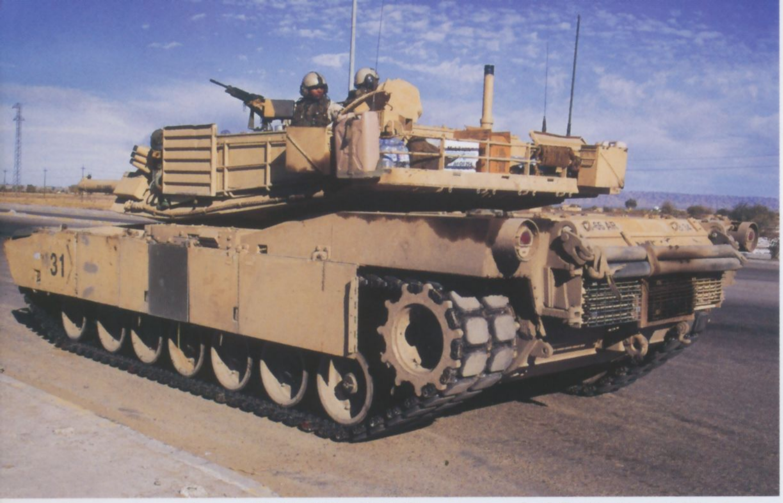
During the initial invasion of Iraq, various M1 MBTs deployed by army units showed very few operational modifications. As in training exercises conducted in CONUS and Europe, tanks featured Joint Combat Identification Marking System (JCIMS) friend-foe identification panels. For obstacle and minefield breaching, one or two MBTs per company were fitted with the Mine Clearing Blade System (MCBS). M1A1 HC tanks of the USMC were fitted with the AN/VLQ-8A Missile Countermeasure Device, an active electro-optical system providing tanks with a self-defense capability against antitank guided missiles that employ infrared-guidance technology. While the army also had the AN/VLQ-8A in its inventory after some 1000 were procured in 1991, the system was not fielded during OIF.

In order to counter threats resulting from employing M1 Abrams in built-up areas of Iraq, the army triggered the Tank Urban Survival Kit (TUSK) program in 2004. TUSK includes a series of protection features meant to increase the survivability of tanks, but also aimed at improving cooperation between tank crews and deployed infantry. In order to speed up the fielding of TUSK, it was decided to use off-the-shelf technology wherever possible, and to issue single components when available. Once all components are fielded the full TUSK will contain the following components: Remote Weapon Station (RWS) (CROWS or M151) or modifications to the commander's machinegun mount to allow firing of the weapon from under armor, Abrams Explosive Reactive Armor (ERA), Rear Protection Unit Slat Armor, Transparent Armor Gun Shield (TAGS), Tank/Infantry Phone, a thermal sight for the loader's machinegun, and Thermal Sight Goggles. Most TUSK items can be installed on all Abrams variants. Fitting the RWS is different on M1A2 SEP and M1A1 variants. It is not known if M1A1 variants will be fitted with an RWS at all, as they already allow the commander's machinegun to be fired from under armor. First TUSK components to be fielded were the Rear Protection Unit Slat Armor, first seen by the author in Iraq in late 2004, and the TAGS first seen in 2005. A first order for the Abrams ERA was issued to GDLS in August 2006. The Abrams ERA tiles are the same kind as those used on the M2/M3 Bradley Infantry/Cavalry Fighting Vehicle.

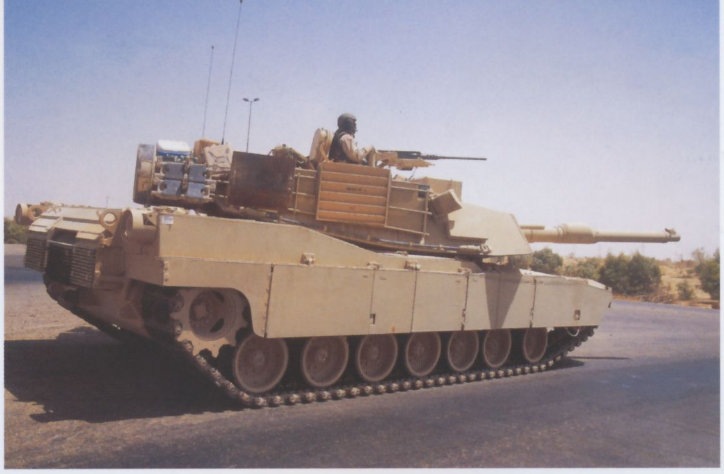
During a sandstorm this M1A1 HA was seen in an overwatch position near MSR Tampa close to Samarra in July 2005. The vehicle belongs to C "Chaos" Company, 2nd Battalion, 69th Armor Regiment. The capacity to maintain a clear view at night or under poor weather conditions via the thermal sight system provides U.S. tankers with an advantage over insurgents who do not have such equipment.



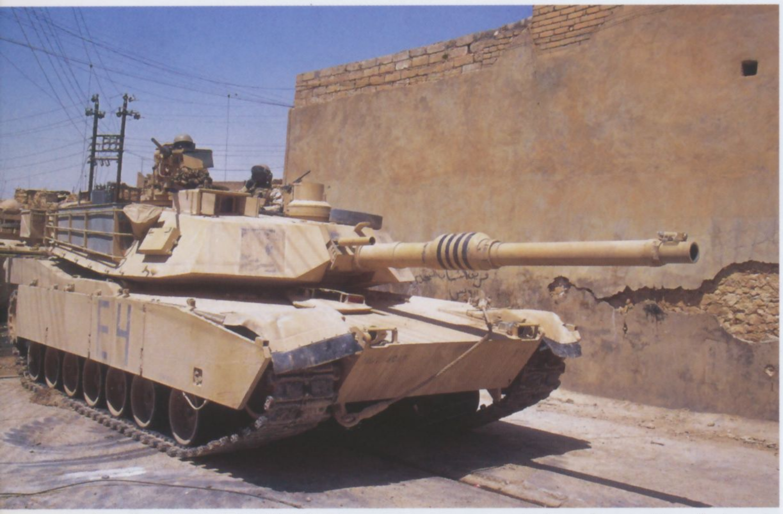
In the TUSK program, several components were developed to improve survivability of the crew. One of these is the TAGS pictured here that allows the loader to operate his machinegun without exposing himself to enemy small-arms fire, while at the same time maintaining his visibility. In this case the TAGS is fitted to an M1A2 of the 3rd Armored Cavalry Regiment on the outskirts of Tall Afar in the summer of 2005.



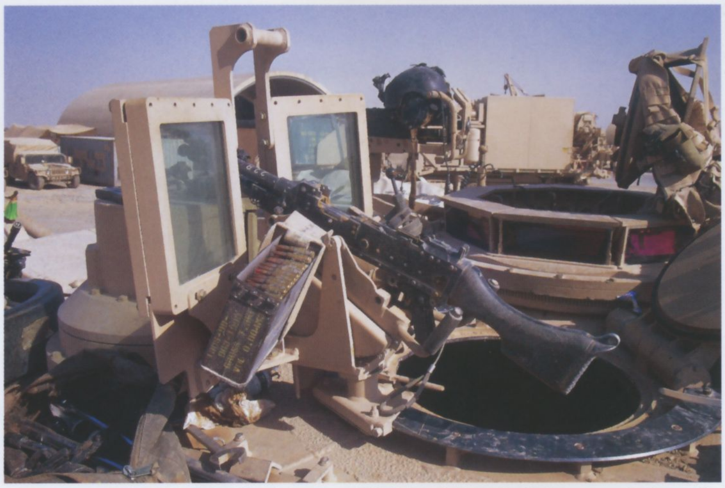
Rear view of an M1A1 HA of B Company, 3rd Battalion, 66th Armor Regiment, in December 2003. Note the Combat Identification Panel (CIP) on the turret side. It belongs to the JCIMS introduced in 1995. JCIMS was adopted as a low-cost interim solution to make identification of friendly vehicles easier, and to therefore reduce the risk of "Blue-on-Blue" engagements.



This picture shows an M1A1 HC Abrams MBT of C Company, 2nd Battalion, 7th Infantry Regiment, in 2005.



In August 2005 this M1A2 Abrams was seen during Operation Saber in the center of Tall Afar in northern Iraq. The vehicle belongs to E "Eagle" Troop, 2nd Squadron, 3rd Armored Cavalry Regiment.

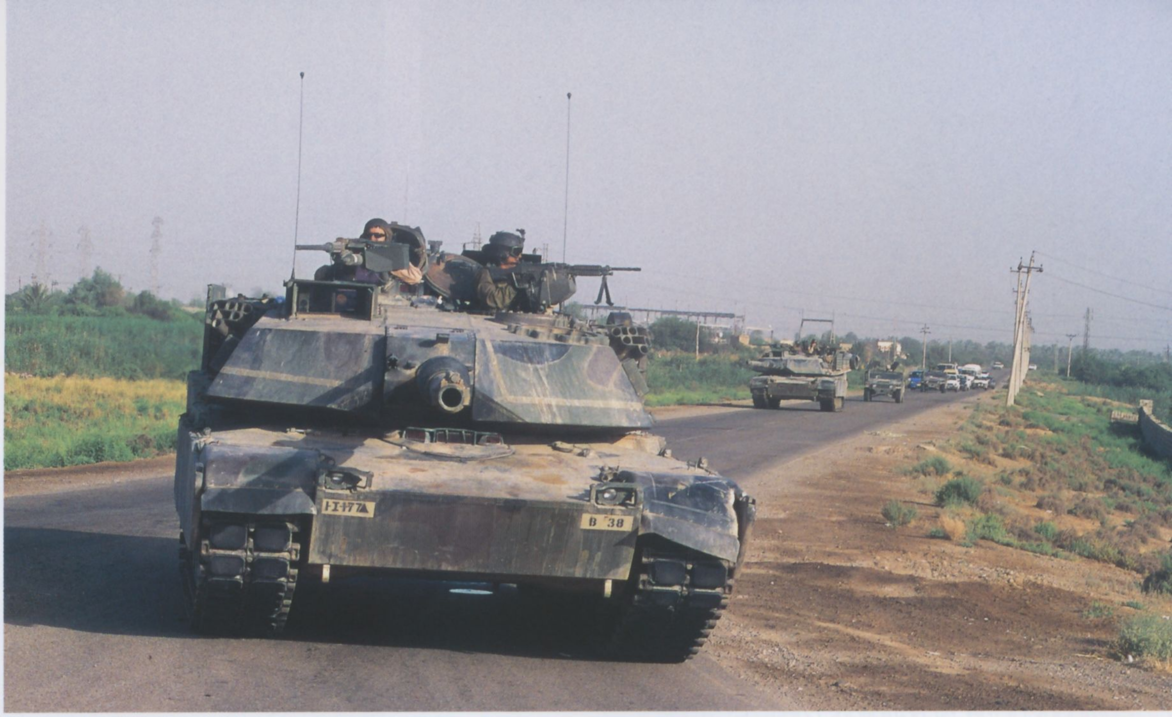


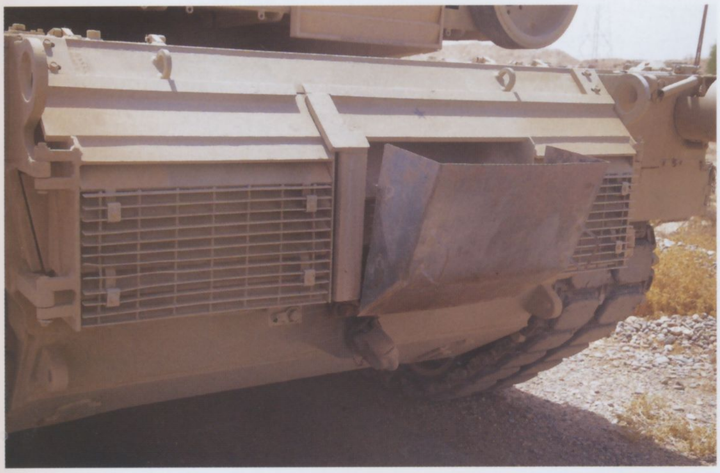
Close-up of a TAGS fitted to an M1A2 of the 3rd Armored Cavalry Regiment. The TAGS, fitted to the existing mount of the loader's machinegun, is only one of a series of additions developed under the TUSK.

Technical Data for M1A2 SEP

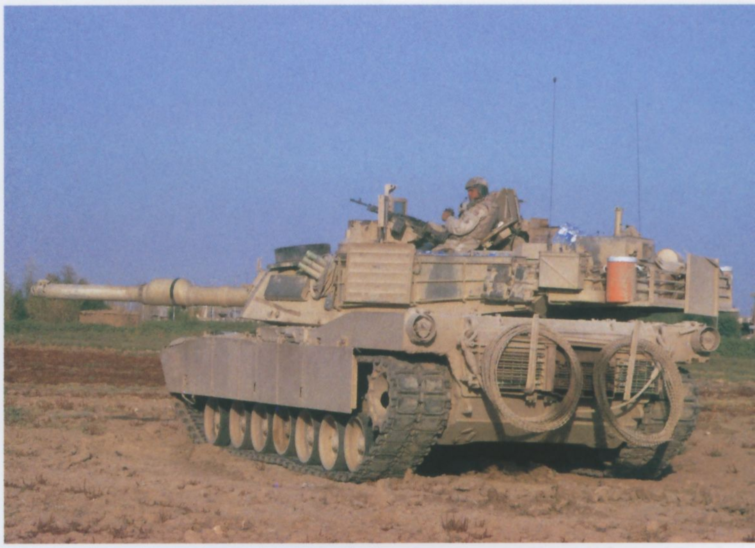
Combat weight:	62,300kg
Crew:	4 (commander, driver, gunner and loader)
Length:	9.827m (with gun forward)
Height:	3.091m
Width:	3.653m
Maximum speed:	67km/h
Cruising range at 46.6km/h:	434km
Fuel tank capacity:	1909 liters
Turning radius:	pivot to infinite
Gradient:	60%
Side slope:	40%
Fording:	1.22m
Trench crossing:	2.74m
Vertical obstacle:	1.24m
Engine:	AGT-1500 multi-fuel air-cooled gas turbine developing 1500hp
Transmission:	X1100-3B with four forward and two reverse speeds
Armament:	1x 120mm M256 smoothbore tank gun, 1x 7.62mm M240 coaxial MG, 1x 7.62mm M240 loader's MG, and 1x 12.7mm M2 commander's MG, 2x M250 Smoke Grenade Launchers (each with six tubes)
Ammunition:	42 rounds 120mm combustible cartridge ammunition, 11,400 rounds for 7.62mm, and 900 rounds for 12.7mm
Other systems:	CTIV, Under-Armor APU, II-Generation Thermal Imaging System, Improved Soldier Machine Interface, Tactical Communication Interface Module, EPLRS, FBCB2/Blue Force Tracker, SICGARS ASIP radios, eye-safe laser rangefinder, Digital Engine Control, Automatic Fire Detection/Suppression System and Mass Memory Unit
Manufacturer:	General Dynamics Land Systems

After the conflict in Iraq turned into a bloody guerilla war, tanks were often used to patrol extremely hostile areas, and along roads where IED incidents occurred regularly. One reason for this practice was that in the first years of the insurgency, the U.S. Army had a severe shortage of suitable armor-protected and mine-resistant patrol vehicles. Here a mixed patrol of M1A1 AIM Abrams and M1114 Up-armored HMMWVs of the 1st Battalion, 77th Armor Regiment, can be seen south of Balad in June 2004.



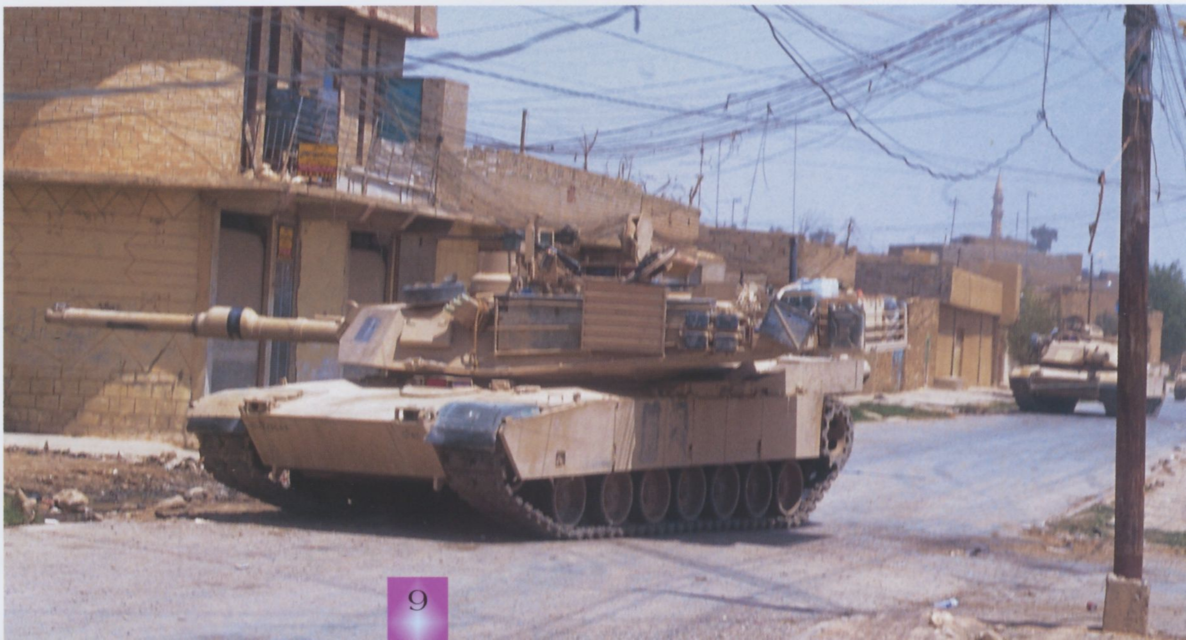


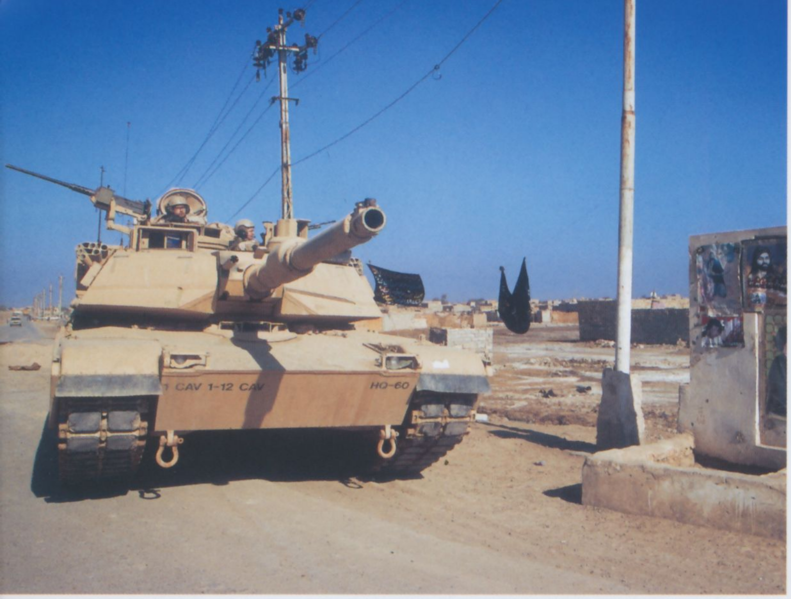
Like all other M1 tank variants, the M1A1 HC is powered by an AGT-1500 multi-fuel air-cooled gas turbine developing 1500hp. The turbine produces extremely hot exhaust fumes that can be hazardous to the crew of other vehicles during recovery operations. Therefore, at the unit level many armor units produced deflectors that are simply hooked onto the grill cover of the turbine exhaust. Instead of being blown out horizontally as usual, the deflectors divert exhaust fumes upwards. The pictured deflector was seen on an M1A1 HC of C Company, 2nd Battalion, 7th Infantry Regiment.



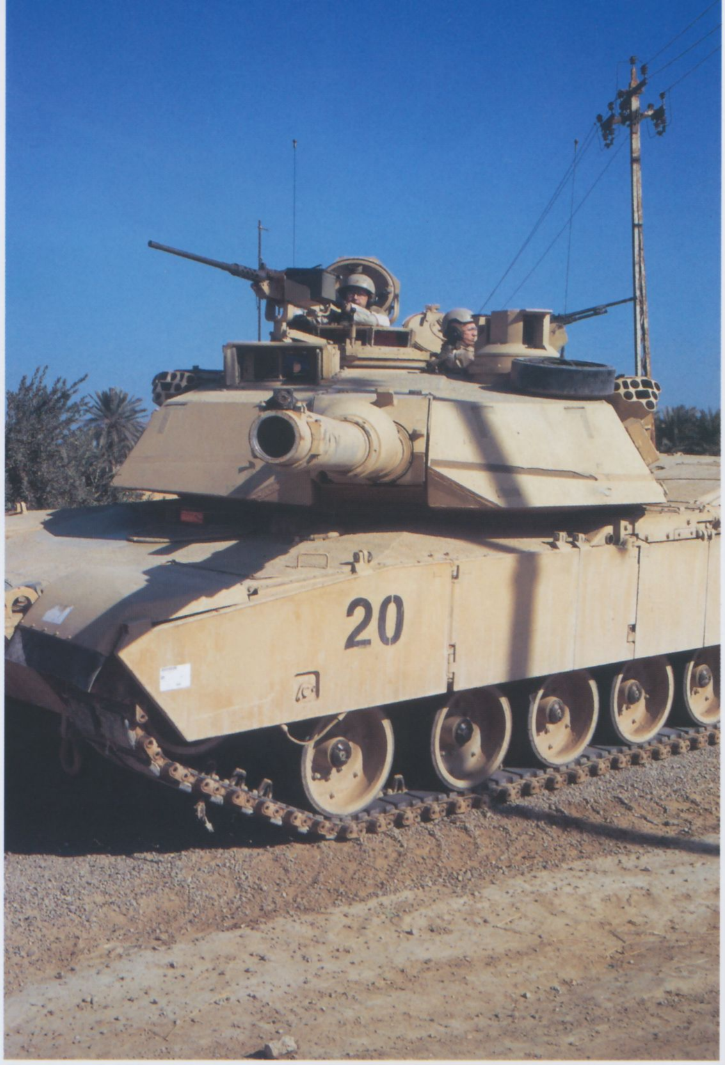
An M1A2 Abrams MBT provides cover for a combined U.S. and Iraqi Army operation in Tall Afar in August 2005. The vehicle belongs to the 2nd Squadron, 3rd Armored Cavalry Regiment. In total, the regiment can field 123 M1A2s in its three squadrons. Each squadron (the equivalent of a battalion) fields 41 M1A2s - nine in each of its three cavalry troops and an additional 14 in its tank company.

This picture was taken during combat in Tall Afar in August 2005. It shows M1A2 Abrams MBTs of the 3rd Armored Cavalry Regiment in the city during a large-scale search operation. Visible is the extended turret bustle rack of the leading tank, as well as the TAGS mounted at the loader's machinegun mount.

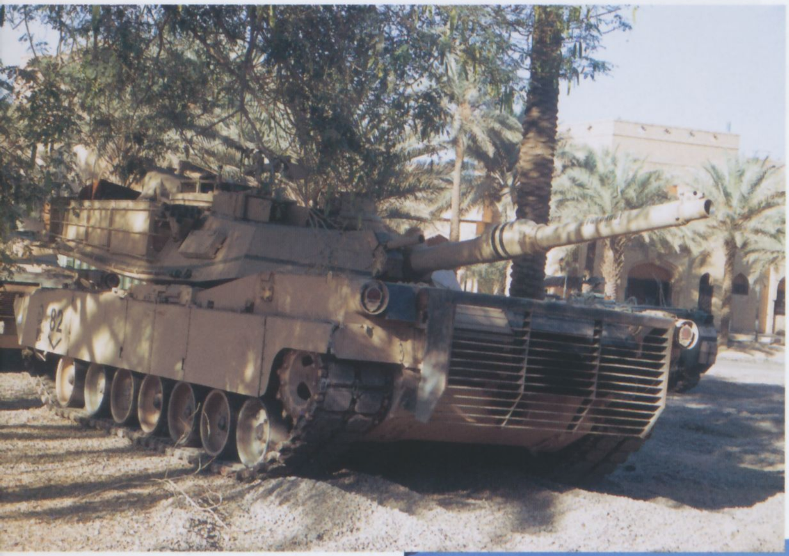




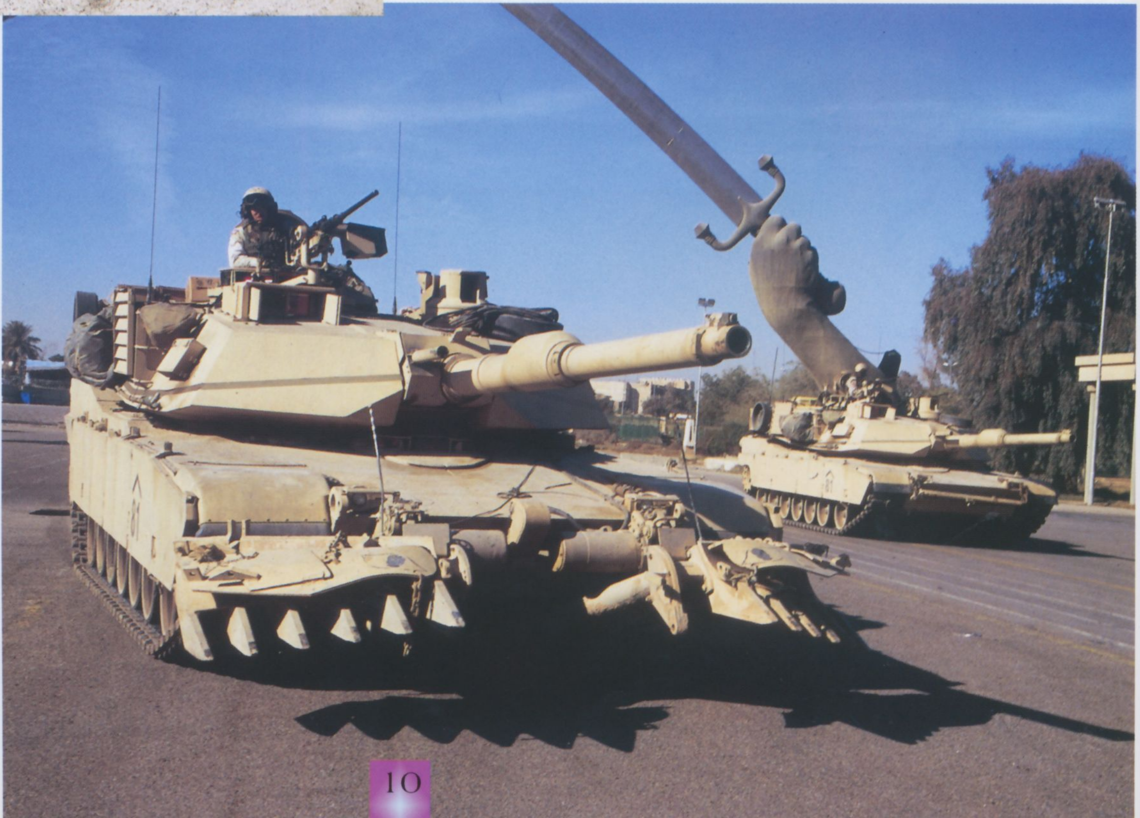
An M1A2 SEP guards a crossroads in eastern Baghdad in December 2004. The road in the background leads to Sadr City, the major stronghold of Shiite insurgents in Iraq. Clearly visible is the commander's 12.7mm M2 machinegun. The tank belongs to HQ Company of the 1st Battalion, 12th Cavalry Regiment.



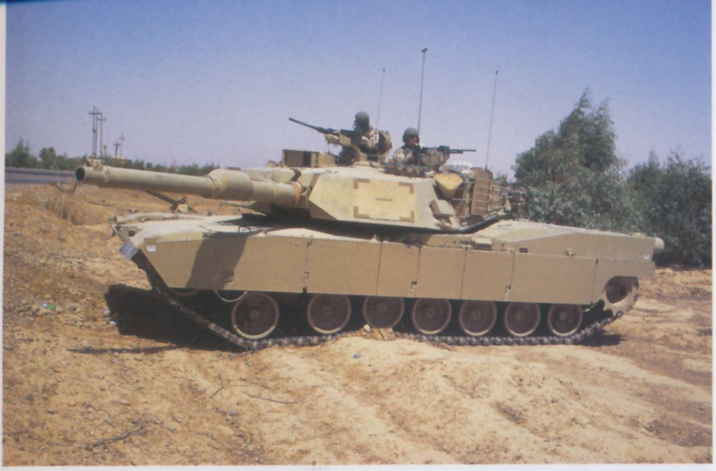
This M1A2 SEP of the 1st Battalion, 12th Cavalry Regiment, was seen in December 2005 on the outskirts of Baghdad. The number "20" of the Combat Vehicle Marking System on the side-skirt identifies it as belonging to the unit's HHC as either the tank of the battalion commander or executive officer.



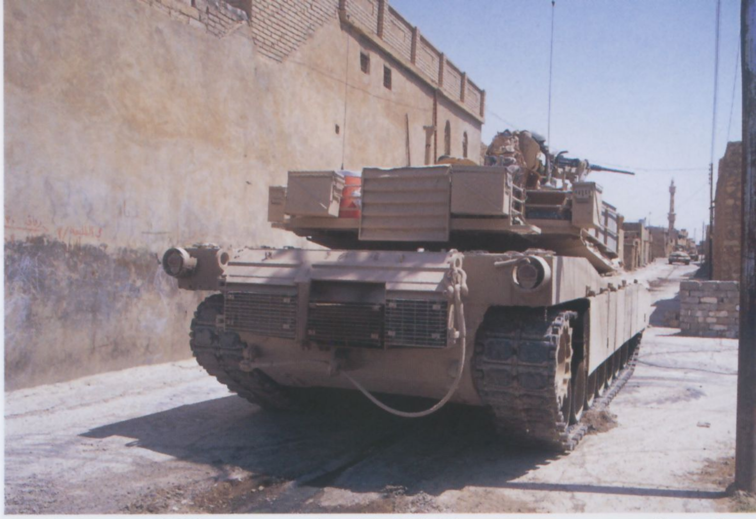
In December 2004 this M1A2 SEP of the 3rd Battalion, 8th Cavalry Regiment, was seen in the Green Zone in Baghdad. The vehicle features Rear Protection Unit Slat Armor, which protects the more vulnerable rear of the tank from attacks by RPG shoulder-launched antitank weapons. The Rear Protection Unit was designed as part of the TUSK.



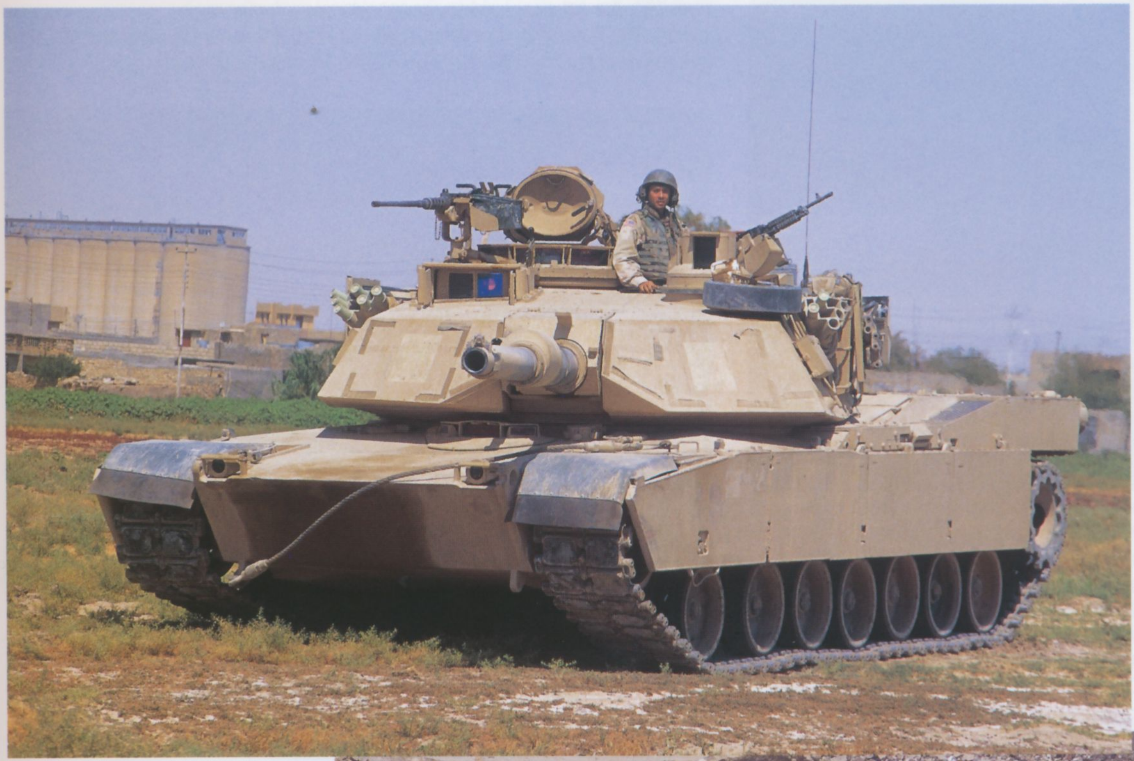
In December 2004 these two M1A2 SEP Abrams of B Company, 3rd Battalion, 8th Cavalry Regiment, were seen in central Baghdad. The first vehicle is fitted with an MCBS designed by RAMTA. The MCBS adds a weight of 4.08 tons. It can be used to clear antitank mines laid under the surface at an operating speed of up to 30km/h.



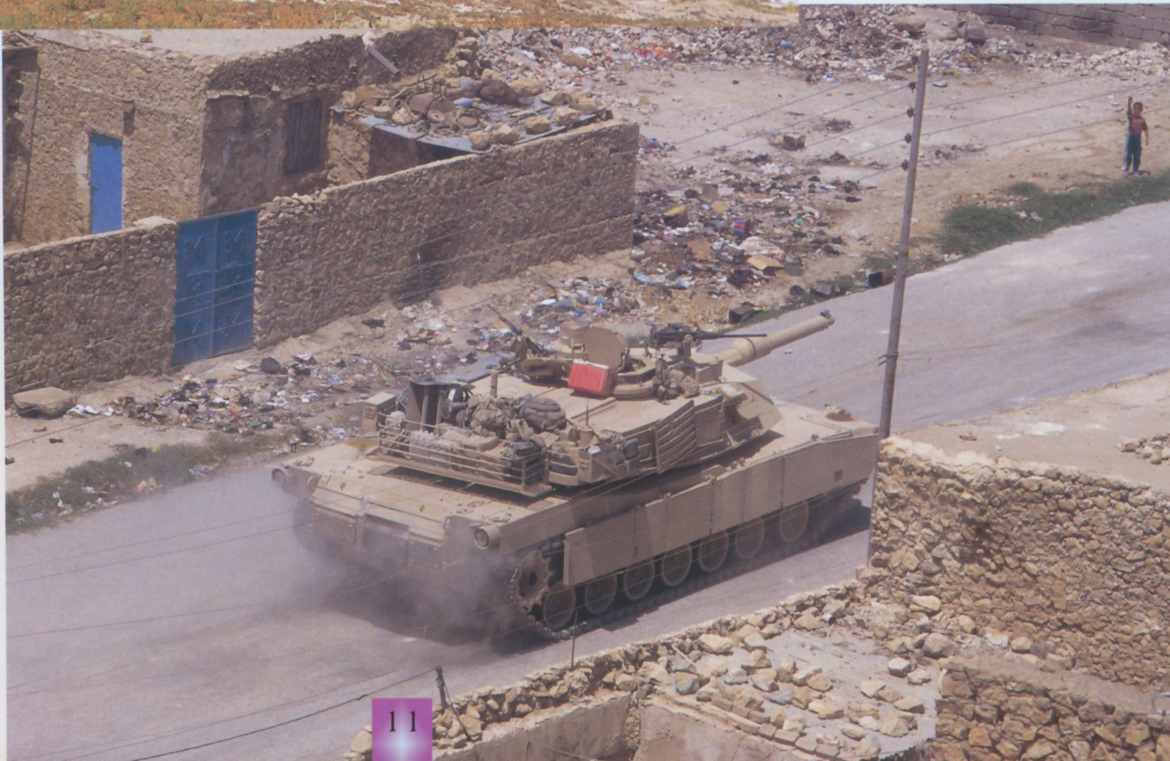
The M1A1 Heavy Common features engineering changes made to fulfill requirements of the USMC such as provisions for a deep-water fording kit. However, M1A1 HC tanks were also fielded by the U.S. Army. This vehicle belongs to the 2nd Battalion, 7th Infantry Regiment, and was seen near Tikrit while on patrol in July 2005.



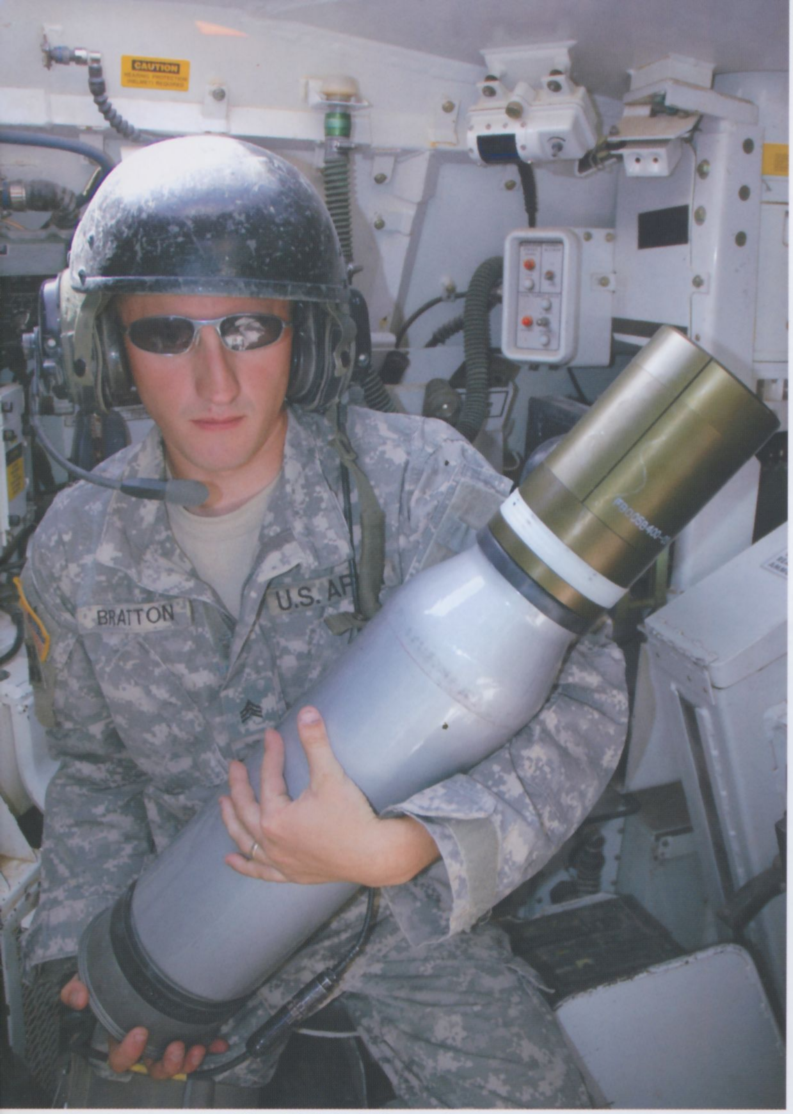
M1A2 Abrams MBTs cover a street in Tall Afar during an operation of the 3rd Armored Cavalry Regiment in August 2005. Note the JCIMS panel mounted on the turret baskets.



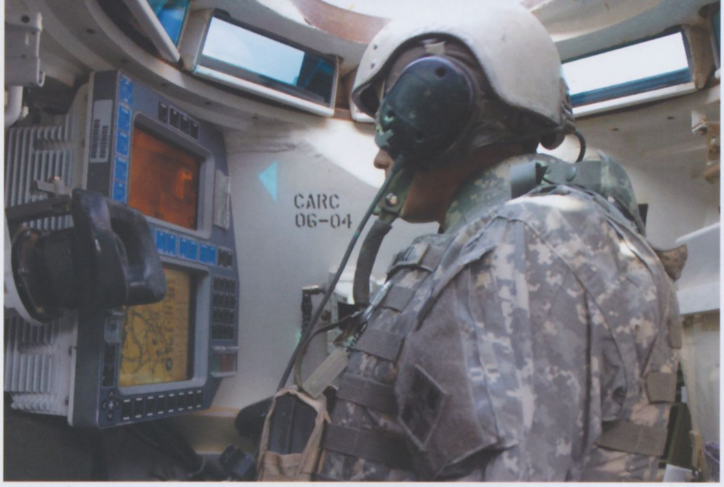
This picture shows another M1A2 Abrams MBT of the 3rd Armored Cavalry Regiment. Evident is the CITV, which provides the crew with a "hunter-killer" capability. The picture was taken in August 2005 on the outskirts of Tall Afar.



An M1A2 Abrams MBT of the 3rd Armored Cavalry Regiment rushes down a street in Tall Afar in August 2005. Despite being more vulnerable to enemy attacks during the insurgency, MBTs have proved their value in support of light forces. During combat operations, it was often MBTs that went in first to gain a point of entry for lighter forces following on.

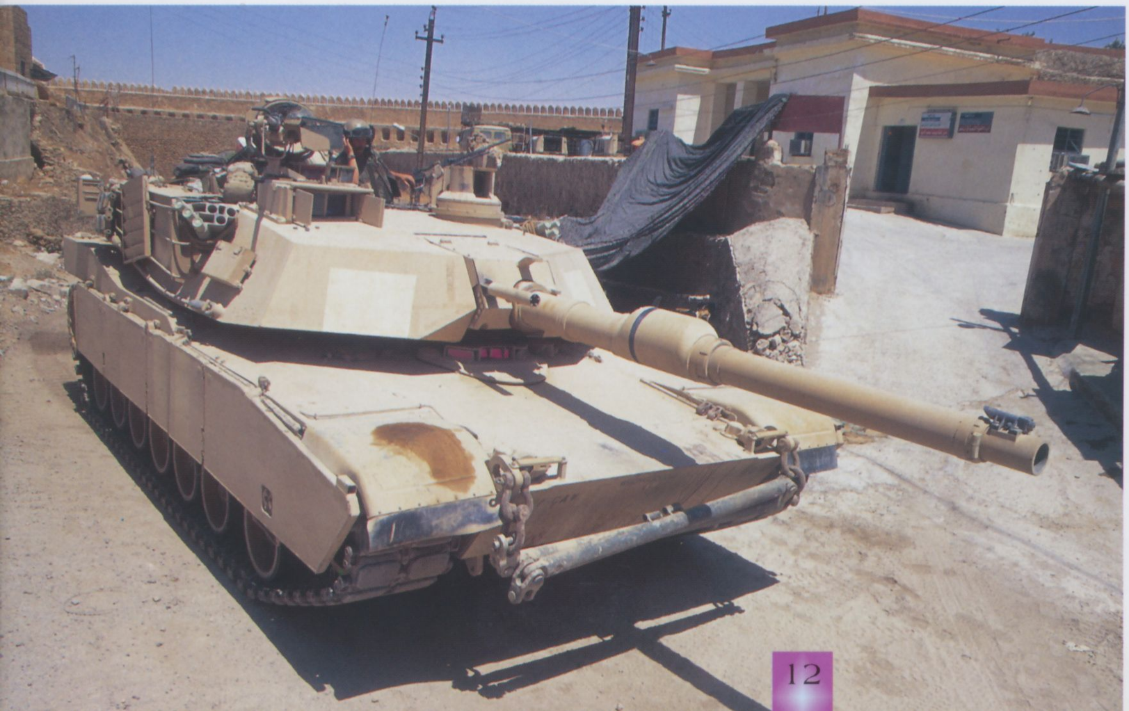


Development of the M1028 120mm Anti-Personnel Tank Round began in order to meet requirements of the 2nd Infantry Division in Korea for a short-range tank-fired anti-personnel cartridge. However, the canister round did not enter service before 2005. It was first fielded to units deployed in Iraq. The M1028 has a combat range of 200-500m and is highly effective against dismounted troops, even those hiding in buildings. It also works well against soft-skin targets like cars being used as Vehicle-Borne IEDs (VBIED). Once the projectile has left the gun barrel, its aluminum body disintegrates and frees the payload of 1100 tungsten balls.

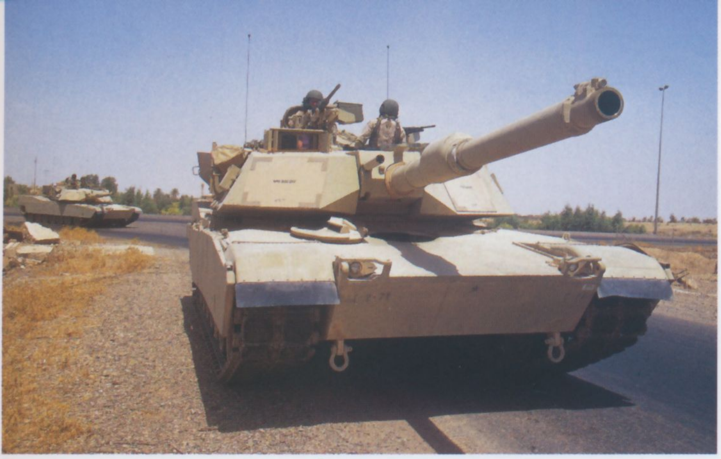


The crews of all M1 Abrams MBT variants consist of four soldiers: commander, driver, gunner and loader. Here the commander of an M1A2 SEP of the 1st Battalion, 68th Armor Regiment "Silver Lions", is pictured operating in the vicinity of Baqubah in 2006. In evidence is the Commander's Display Unit in front of his seat. The CDU includes controls for all the tank's main systems, two screens showing images captured by the sight system and CITV, as well as information generated by the FBCB2/Blue Force Tracker.

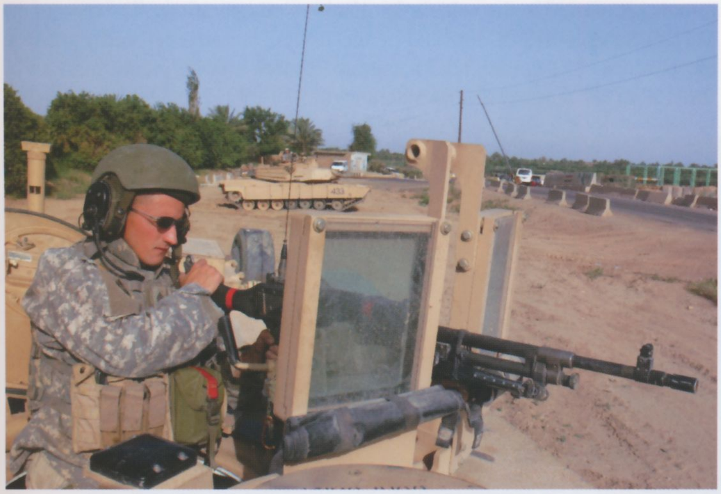
The M1A2 SEP is powered by an AGT-1500 multi-fuel gas turbine, and with 1909 liters of JP-8 it has a cruising range of 434km. Here an M1A2 SEP of the 1st Battalion, 68th Armor Regiment, can be seen accelerating during a patrol along the Tigris River near Baqubah.



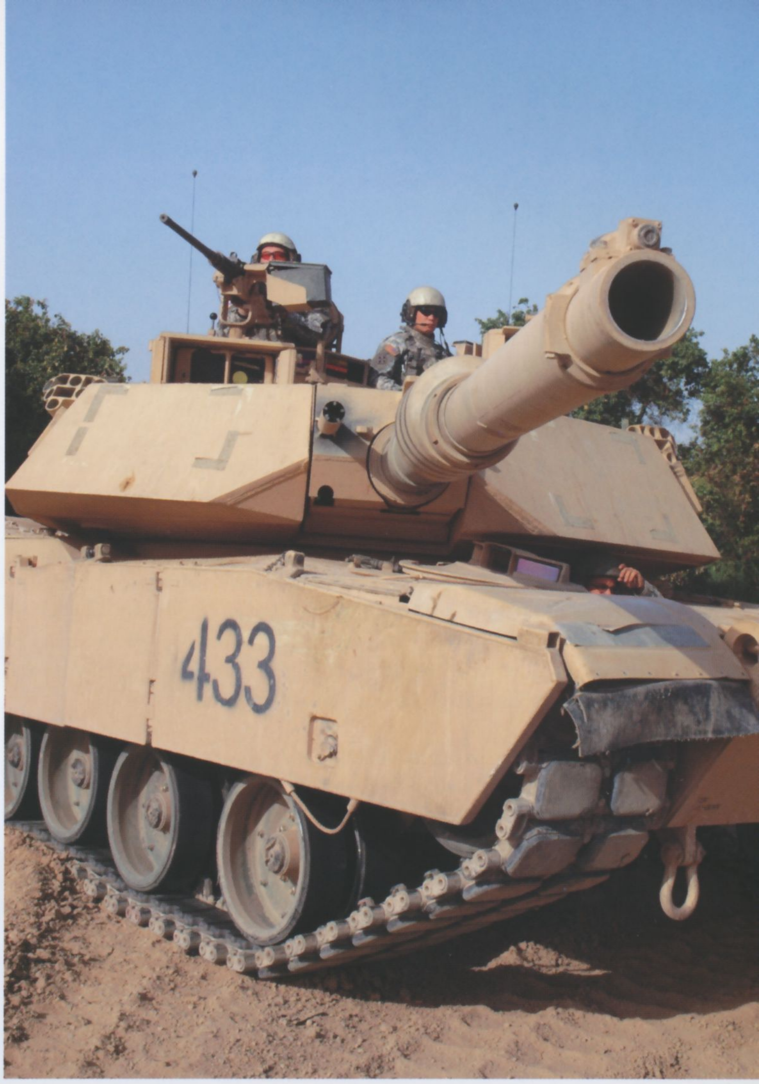
During a patrol in Tall Afar, an M1A2 Abrams MBT passes the old fortress in the city center. The vehicle belongs to the 2nd Squadron, 3rd Armored Cavalry Regiment, and was seen in August 2005. Note the CITV on the left turret side.



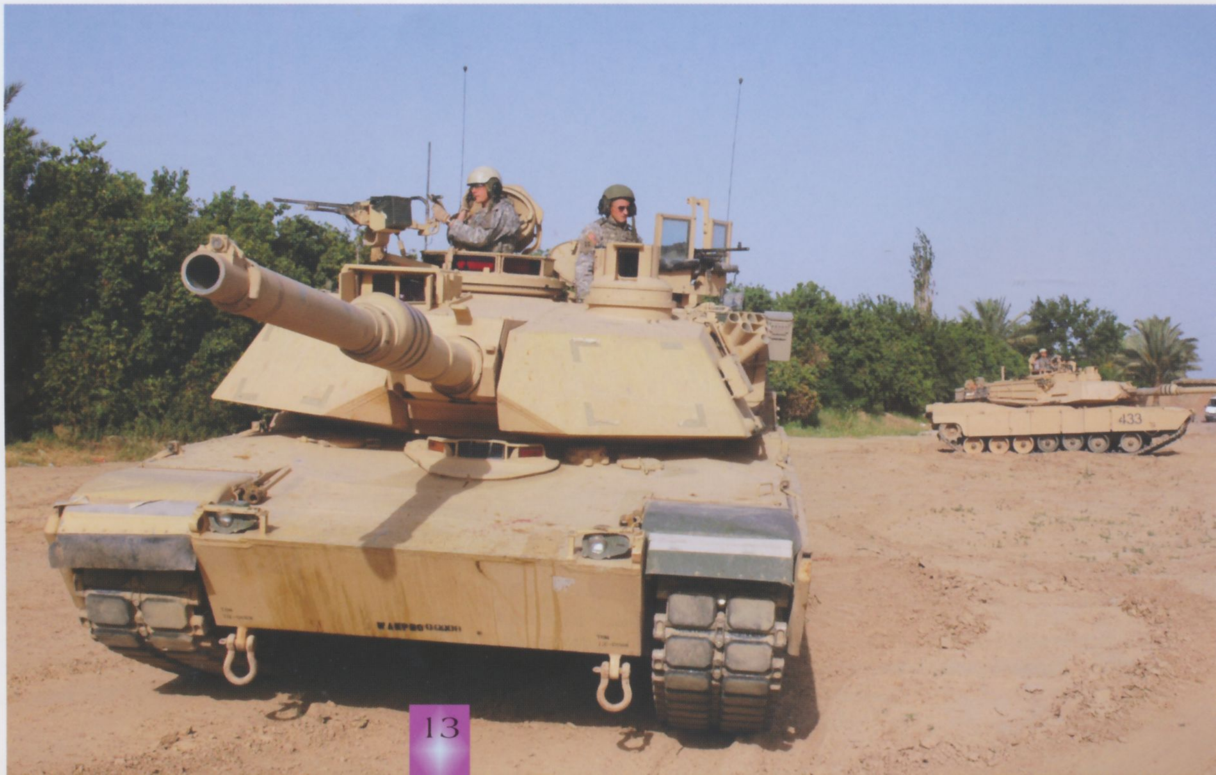
This patrol of two M1A1 HC tanks was seen south of Tikrit in the summer of 2006. The vehicle belongs to C Company, 1st Battalion, 7th Infantry Regiment. This battalion belonged to a brigade organized according to the new Brigade Unit of Action structure that no longer has homogenous armor and mechanized infantry battalions. Instead, though retaining the terms Armor and Infantry, the battalions now comprise an HHC, two mechanized infantry companies (A and B), two tank companies (C and D), and an engineer company (E). Each of the two tank companies fields 14 MBTs.



The loader of an M1A2 SEP of the 1st Battalion, 68th Armor Regiment, mans the roof-mounted 7.62mm M240 machinegun, protected by a TAGS. Note the GPS antenna belonging to the vehicle's EPLRS. Behind the loader is the wind sensor of the fire control system.



The business end of an M1A2 SEP Abrams. M1A1s and M1A2s were converted into M1A2 SEP Abrams. By late 2007 a total of 1100 M1A2 SEPs had been ordered or already fielded. The M256 smoothbore gun can fire a wide range of 120mm combustible cartridges including the M830A1 High Explosive Anti-Tank Multi-Purpose Tracer (HEAT MP-T), M1028 120mm Anti-Personnel Tank Round, and M829A2 Armor-Piercing Fin-Stabilized, Discarding Sabot-Tracer (APFSDS-T). The pictured vehicle belongs to the 1st Battalion, 68th Armor Regiment "Silver Lions", seen near Baqubah in 2006.



This pair of M1A2 SEP Abrams MBTs belongs to the 1st Battalion, 68th Armor Regiment "Silver Lions", and was seen northwest of Baqubah during a patrol in 2006. Both tanks have TAGS fitted to the loader's machinegun mount.

Stryker Interim Armored Vehicle

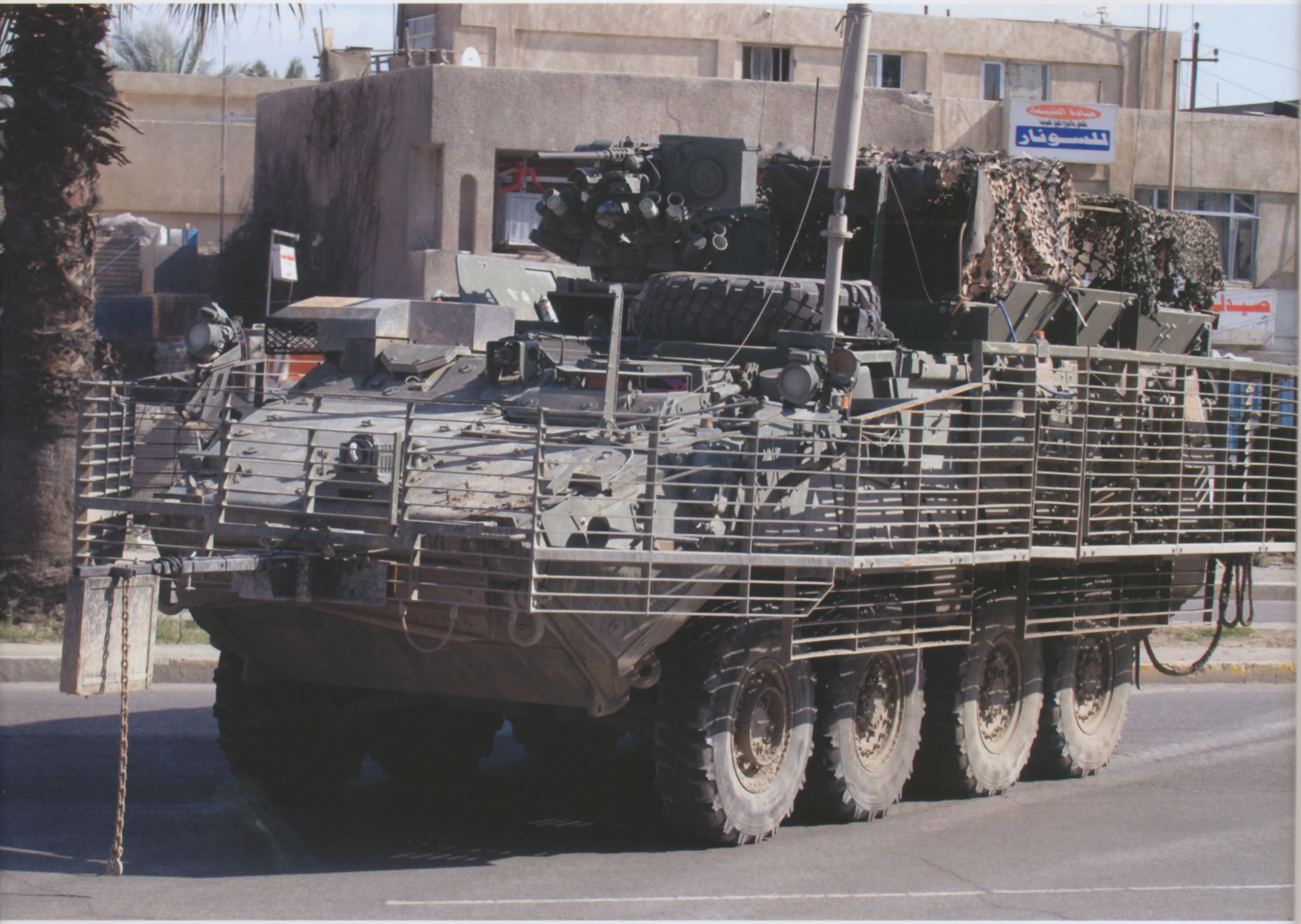
The Stryker Interim Armored Vehicle (IAV) was designed and procured by the U.S. Army to equip newly formed Interim Brigade Combat Teams that later became known as Stryker Brigade Combat Teams. SBCTs fill the capability gap between light and heavy forces in the U.S. Army. A SBCT is a full-spectrum combat force that can operate in all environments, dealing with low- and mid-range threats that may employ either conventional or asymmetric tactics. SBCTs are optimized primarily for employment in small-scale contingency operations in complex and urban terrain. The infantry-heavy SBCTs feature a high dismount strength and they can be deployed within 96 hours anywhere in the world. In 2003 the U.S. Army deployed an SBCT for the first time in an operational theater as part of OIF, namely the 3rd Brigade, 2nd Infantry Division. At that time the brigade could only field eight of the ten Stryker IAV family variants, as two were still under development. By 2007 this had changed and all ten vehicles were being operated by the three SBCTs deployed in Iraq:

M1126 Stryker Infantry Carrier Vehicle (ICV) is fitted with the M151 Protector RWS and has a driver and commander for its crew. A squad of nine dismounts is transported in the rear fighting compartment, leaving and entering the vehicle via a large power-operated rear ramp.

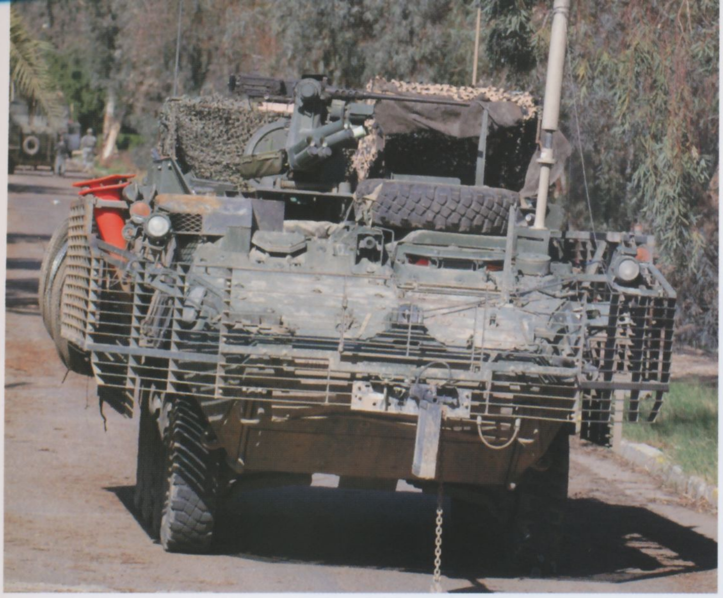
M1127 Stryker Reconnaissance Vehicle (RV) serves as a highly mobile platform for the Long-Range Advanced Scout Surveillance System (LRAS3). Its crew consists of the driver and commander. A five-man scout squad is seated in the rear compartment. The vehicle is fitted with a power-operated, 360° traversable commander's cupola on which the LRAS3 and a pintle for crew-served weapons such as a 12.7mm M2 heavy machinegun or 40mm Mk19 MOD3 automatic grenade launcher are located.

M1128 Stryker Mobile Gun System (MGS) is a wheeled light tank with a 105mm M68A1E4 rifled tank gun as its main armament. The MGS features an automatic loader for the gun and carries 18 105mm rounds. The vehicle also features a coaxial 7.62mm M240B machinegun and 12.7mm M2 machinegun mounted at the commander's cupola. The crew consists of the driver, commander and gunner.

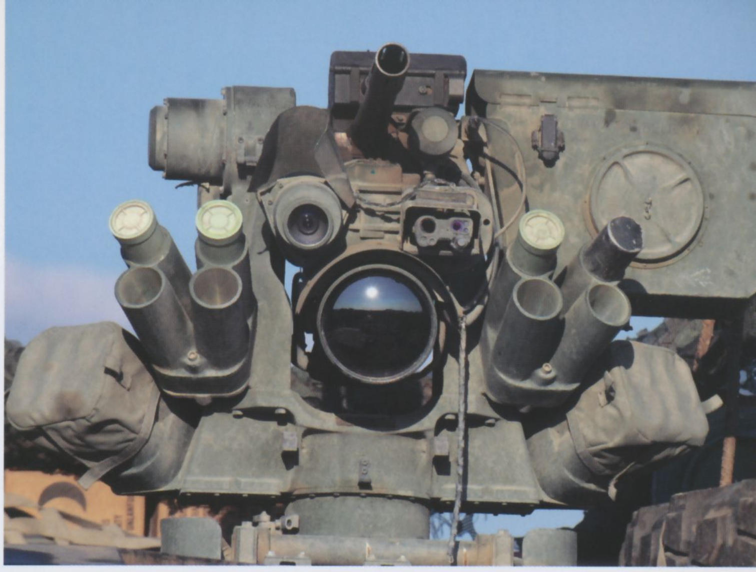
M1129 Stryker Mortar Carrier (MC). There are two MC models, the older MC-A and the newer MC-B. While on the MC-A the mortar could not be fired from the vehicle, this changed with the MC-B. The MC-B features a 120mm Recoiling Mortar System (RMS) 6-L that is mounted on a base plate traversable by 4400 mills in the rear fighting compartment. The mortar system has a range of 6700m and vehicles used by infantry companies have a combat load of 48 120mm mortar rounds. In addition, a 60mm M224 mortar with 77 rounds or an 81mm M252 mortar with 35 rounds are carried in the vehicle for dismounted operations. The crew of the M1129 Stryker MC-B consists of the driver, commander and three-man mortar crew. The commander's station features a skate mount that can be fitted with a 7.62mm M240B machinegun.



The basic variant of the Stryker IAV family is the M1126 Stryker ICV. The vehicle is manned by a driver, commander, squad leader and two four-man fire teams. Today almost all M1126 Strykers deployed to Iraq are fitted with slat stand-off armor, blast plates around the hull roof and ECM systems. This vehicle belongs to the 1st Battalion, 23rd Infantry Regiment.



Strykers offer crews a high degree of protection. The hull is made of High Hard Steel armor, and onto this a layer of MEXAS 2C ceramic armor is mounted. Inside the vehicle is a Kevlar spall liner. Here an M1126 Stryker ICV of the 1st Battalion, 23rd Infantry Regiment, can be seen in Baghdad in March 2007.



The M151 Protector RWS is mounted on the M1126 ICV, M1129 MC-A, M1130 CV, M1132 ESV and M1135 NBCRV. The sensor package of the RWS includes a CCD day camera, thermal-imaging module and laser rangefinder. The pictured M151 Protector RWS can be identified as a Block I model as it features a STORM micro-laser rangefinder.

M1130 Stryker Command Vehicle (CV) is a command post on wheels, and therefore features a comprehensive range of data-processing and communication equipment such as several ASIP radios and a satellite communication system. The vehicle is fitted with the M151 Protector RWS and has a crew of five consisting of the driver, commander, staff officer and two workstation operators.

M1131 Stryker Fire Support Vehicle (FSV) features all necessary equipment required by the embarked Fire Support Team to conduct automated fire-support planning, directing and coordination. One major part of the mission-related equipment is the Fire Support Sensor System Mission Equipment Package mounted at the commander's cupola. The vehicle is fitted with a pintle-mounted 12.7mm M2 heavy machinegun. The crew consists of the driver, commander and two additional FIST members.

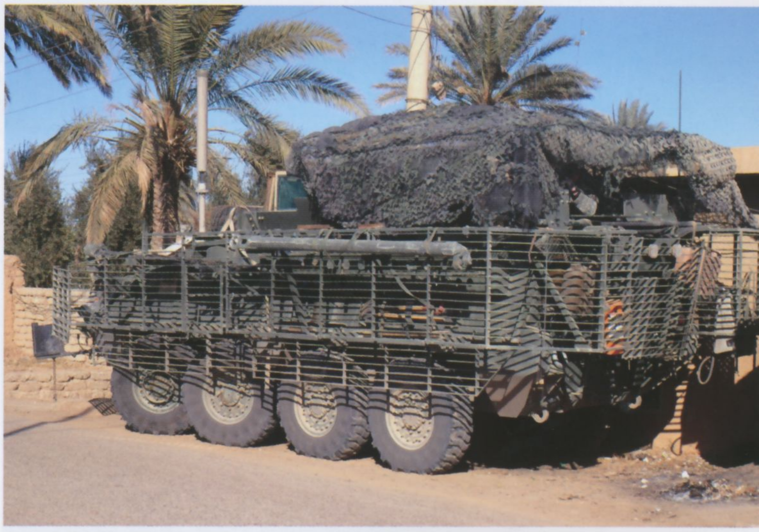
M1132 Stryker Engineer Squad Vehicle (ESV) is basically identical to the M1126 Stryker ICV, but its interior has been modified to allow the storage of engineer equipment. A Jettison Fitting Kit is mounted at the front to allow the fitting of the following equipment: Surface Mine Plow, Angled Mine Plow, Lightweight Mine Roller or Surface Obstacle Blade. The vehicle can also be fitted with a Magnetic Signature Duplicator and Lane Marking System. Like the ICV, the ESV is fitted with the M151 Protector RWS. It has a crew consisting of the driver and commander. In the rear fighting compartment a nine-man engineer squad is transported.

M1133 Stryker Medical Evacuation Vehicle (MEV) is the ambulance version and in its rear compartment four wounded on stretchers, or six seated wounded, or a mixture of two wounded on stretchers and three seated wounded, can be transported. The vehicle features extensive medical equipment and a power-operated litter lift system. The crew consists of the driver, commander and medical attendant.

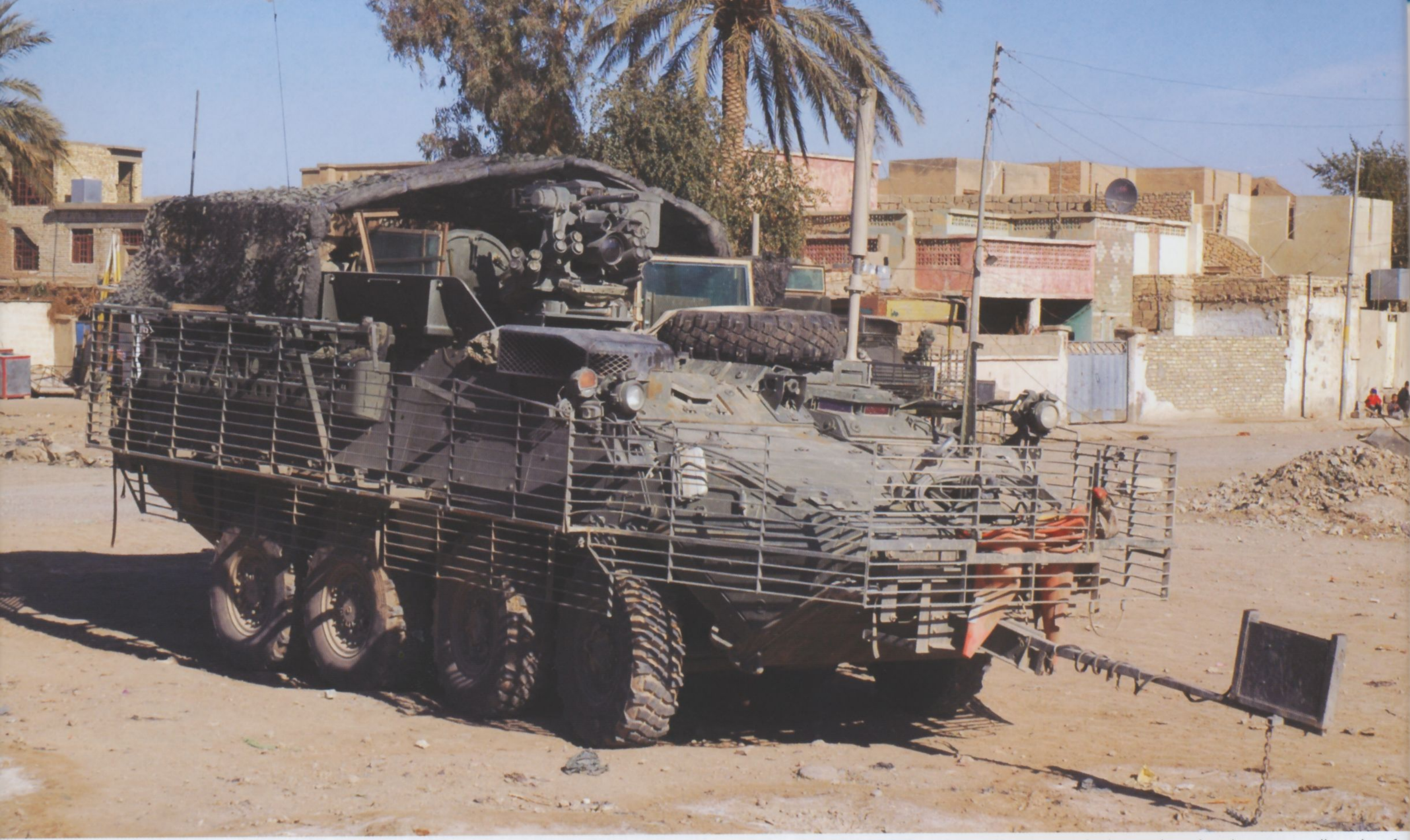
M1134 Stryker Anti-Tank Guided Missile Vehicle (ATGM) is the tank killer of the Stryker family. It is equipped with an Elevated TOW System (ETS) featuring two missile launch tubes, the Modified Improved Target Acquisition System and Fire Control System. The ETS can be raised 550mm and rotated 360°. With the TOW missile system, the vehicle can destroy all known enemy armor out to a range of 3750m. Inside the vehicle are 12 missiles. The crew consists of the driver, commander, gunner and loader.

M1135 Stryker NBC Reconnaissance Vehicle (NBCRV) is a laboratory on wheels used to detect and identify contamination caused by NBC weapons. Detection equipment includes a Chemical Biological Mass Spectrometer (CBMS), Joint Biological Point Detection System (JBPDS), Stryker Chemical Agent Detector (SCAD) and Chemical Vapor Sampling System (CVSS). Like the ICV, the vehicle is fitted with the M151 Protector RWS. The crew consists of the driver, commander and surveyor.

The search for an IAV started after the U.S. Army officially announced the formation of six IBCTs in 1999. Due to cost and time reasons, it was decided to procure an off-the-shelf solution. After a market survey, a Platform Performance Demonstration, and a close evaluation of borrowed Canadian LAV IIIs, this vehicle was chosen to become the IAV in November 2000. LRIP of the first eight IAV variants (the M1128 and M1135 were not ready yet) began in mid-2001. On 27 February 2002, the army officially named the IAV "Stryker" in a ceremony at Fort Lauderdale, Florida. The name originated from that of two Medal of Honor recipients, namely Pfc Stuart S. Stryker, who served in WWII, and Spc Robert F. Stryker, who served in Vietnam. Up till 2006, the U.S. Army had ordered 2691 Stryker IAVs in different variants to equip seven SBCTs.



This M1126 Stryker ICV belongs to A Company, 1st Battalion, 38th Infantry Regiment, and was seen in January 2008. It is common practice for units in Iraq to mount a canopy over the rear of their vehicles. Usually this consists of a frame of metal bars constructed at the unit level and a camouflage net. The canopy has three effects – it obstructs the vision of snipers aiming at troops standing in air-guard hatches; it prevents the enemy from lobbing hand grenades or other explosives through an open hatch; and it protects troops standing in the hatches from the heat of the Iraqi sun.

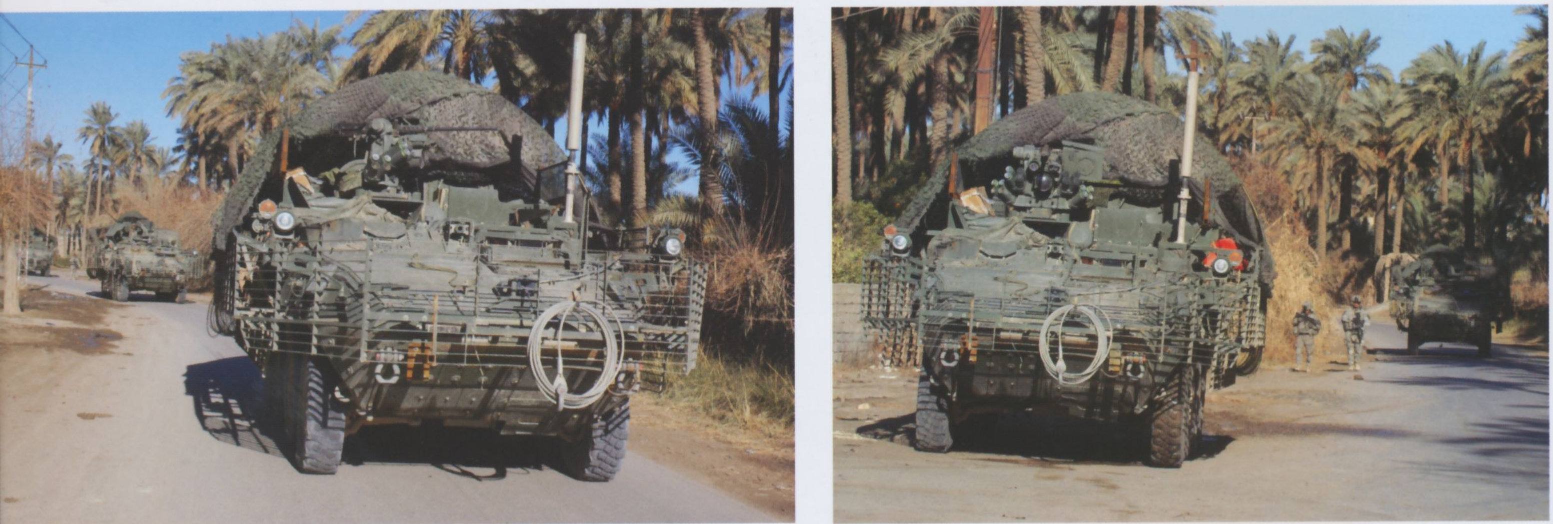


The M151 Protector RWS of this M1126 Stryker ICV has been fitted with a 40mm Mk19 MOD3 automatic grenade launcher. In view are all sorts of vehicle modifications to make it suitable for the challenging threat level of OIF deployments. These include slat armor, blast plates, Rhino and Warlock ECM systems, engine-exhaust deflector, and transparent armor designed at the unit level. The vehicle belongs to A Company, 1st Battalion, 38th Infantry Regiment, and was seen in Baqubah in early 2008.

A short technical brief of the M1126 Stryker ICV

The M1126 Stryker ICV is a permanent four-wheel drive, selectively eight-wheel drive, wheeled APC. The crew consists of 11 soldiers, namely the driver, commander and a nine-man dismount squad. The vehicle has a combat weight of 18,300kg and features a composite armor package consisting of High Hardness Steel, a suite of MEXAS 2C (Modular Expandable Armor System 2C) ceramic armor and a Kevlar spall liner. The armor can withstand hits of 14.5mm armor-piercing rounds and artillery fragments. Inside the hull the driver is seated at the front left. To his right is the power pack, a 7.2-liter Caterpillar 3126 I6 with Hydraulically-actuated Electronically-controlled Unit Injector (HEUI), exhaust turbocharged, water-cooled, six-cylinder JP8/diesel engine, and six-speed Allison MD 3066P electronically controlled automatic transmission. The engine develops 350hp at 2500rpm and allows the vehicle to reach a top speed of 101km/h. With fuel from the two 100-liter tanks, the vehicle has a road range of 450km. For driving at night or low visibility, the vehicle is fitted with an AN/VAS-5 DVE.

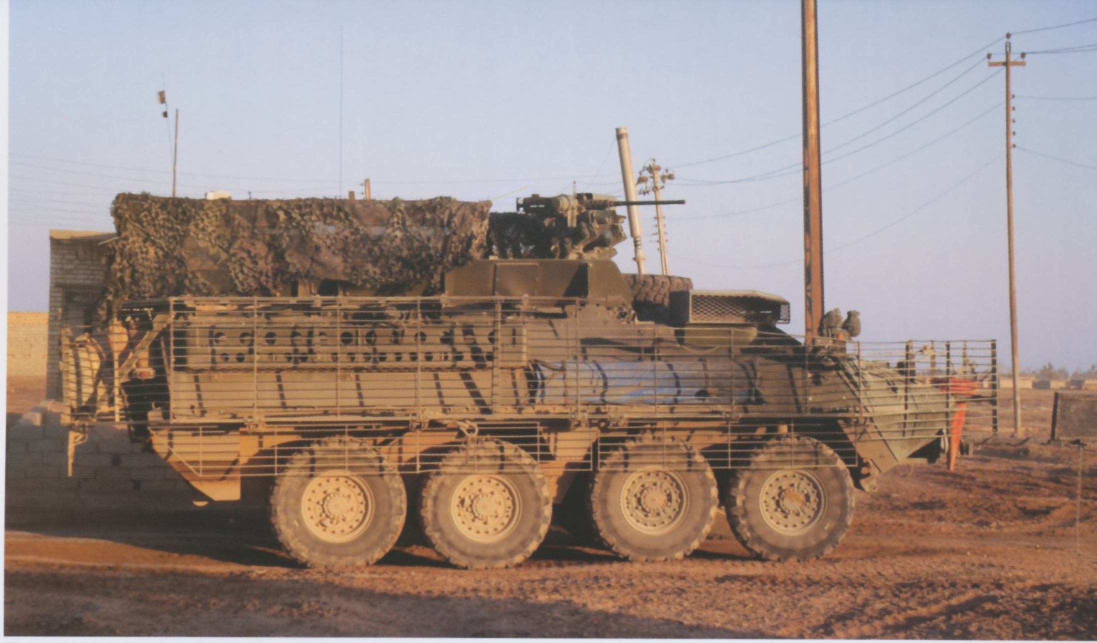
The Stryker features a power-assisted steering system that actuates the two front axles. The vehicle has a turning radius of 16m. Suspension on the eight-wheeled vehicle is of the independent hydropneumatic type and contains a height management system. It allows the vehicle to negotiate gradients of up to 60%, side slopes of up to 30%, vertical steps up to 600mm high, and trenches 2m wide. Water obstacles up to a depth of 1.3m

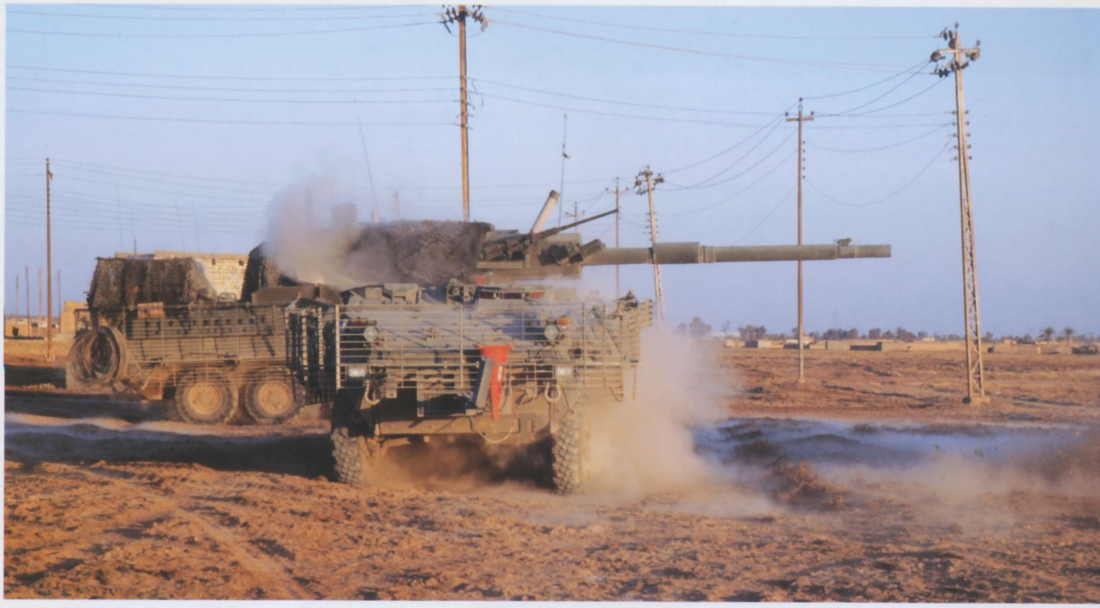


Here a patrol of A "Able" Company, 4th Battalion, 9th Infantry Regiment, can be seen operating in a rural area north of Baqubah. The first patrol vehicle is an M1126 Stryker ICV, and the second an M1131 Stryker FSV. In Iraq the vehicle inventory of A Company includes three M1128 Stryker MGS, one M1131 Stryker FSV, two M1129 Stryker MC-B, one M1133 Stryker MEV and 14 M1126 Stryker ICV variants.

can be forded. CTIS further benefits the vehicle's cross-country capabilities and run-flat tires allow the crew to continue a mission even when the tires are punctured. The brake system consists of dual-circuit, hydraulically compressed, air-assisted power brakes on all wheels, plus ABS.

The commander is seated behind the engine compartment. The squad leader's seat is located to his left. The M151 Protector RWS is mounted on the roof behind the engine compartment in front of the commander's hatch. It can be fitted with either a 12.7mm M2 machinegun or 40mm Mk19 MOD3 automatic grenade launcher. The M151 Protector RWS is controlled by the commander via a Fire Control Unit incorporating a joystick mounted in front of his seat. The RWS sensor package includes a zoomable CCD day camera, thermal imaging system and integrated laser rangefinder. The RWS can be traversed 360°, while the mounted weapon can be elevated from –20° to +55°. Four M6 smoke grenade dischargers are fitted to the RWS, each featuring four 66mm barrels.


This M1126 Stryker ICV of A Company, 1st Battalion, 38th Infantry Regiment, was seen during a patrol on the outskirts of Baqubah in January 2008. Note the slat armor and blast plates around the roof, as well as the Rhino and Warlock ECM systems.

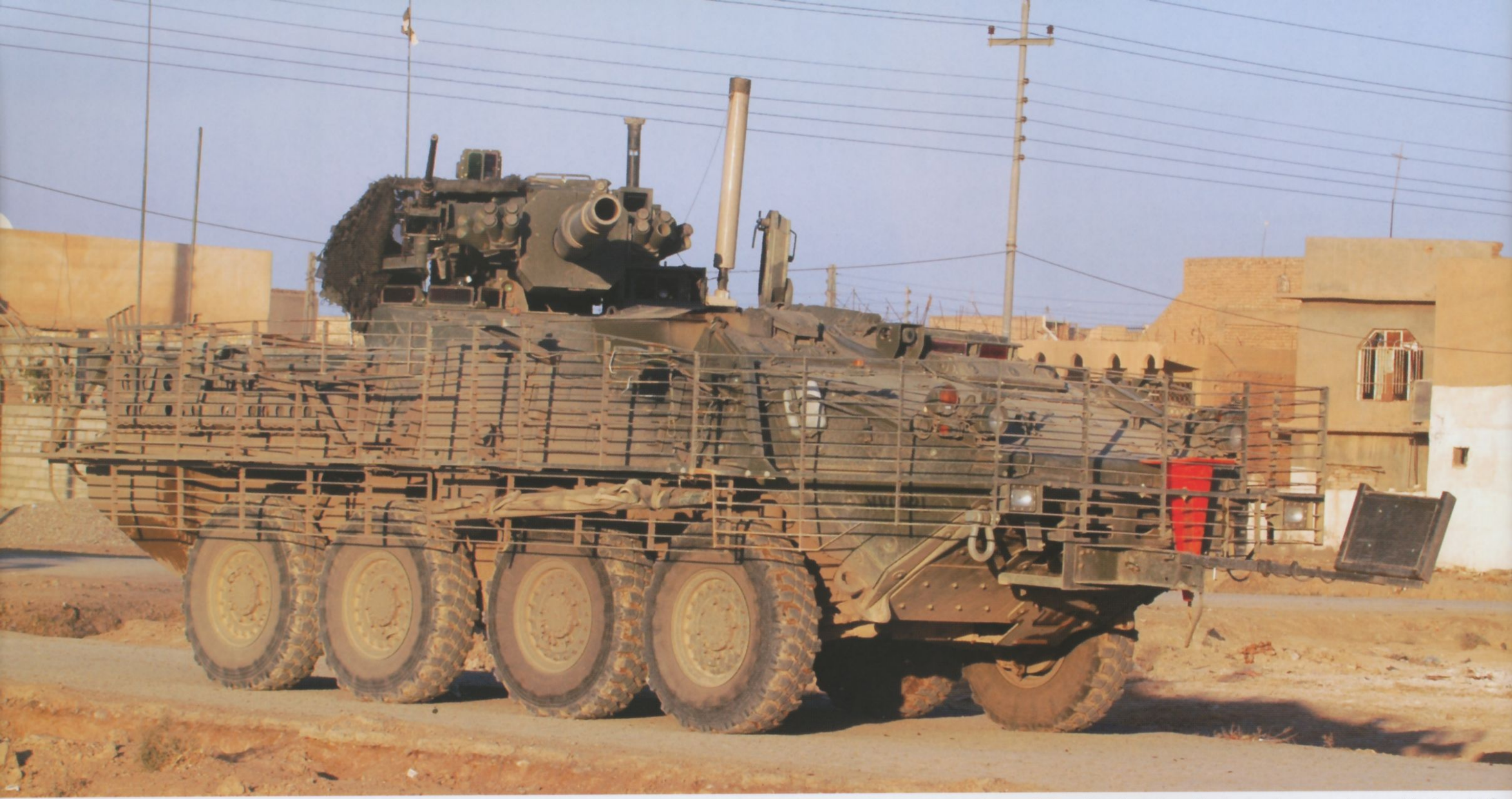

An M1128 Stryker MGS opens fire while on patrol in Baqubah in January 2008. The vehicle has just fired a 105mm M1040 canister round with its M68A1E4 rifled tank gun. With this round containing a large number of tungsten balls, dismounted troops can be engaged at a range of 50-500m, in either open or built-up areas.

In the rear compartment the eight-man infantry squad is seated on two benches running down the left and right sides facing inwards. In the roof above the troop compartment are two large single-piece hatches called air-guard hatches. Access to the troop compartment is via a large power-operated rear ramp. In the ramp is a small door that allows personnel to enter and leave without dropping the ramp. Stored behind the benches are antitank weapons, ammunition and personal equipment, along with radios and other electronic equipment. More personal equipment and ammunition is stored outside on the roof and in baskets along the side walls of the hull. Among other systems, the Stryker is fitted with three ASIP radios, FBCB2/Blue Force Tracker digital C ^{2} system, AN/VSQ-2 (V) 1 Enhanced Position Location Reporting System, DAGR, video-display terminals for the commander and squad leader, automatic fire extinguishing system, MRE heater, NBC protection system, APU, NBC ventilation system, diesel fuel-fired personnel and engine coolant circulation heater, hydraulic winch with a pull capacity of 9,525kg, and two wire cutters.

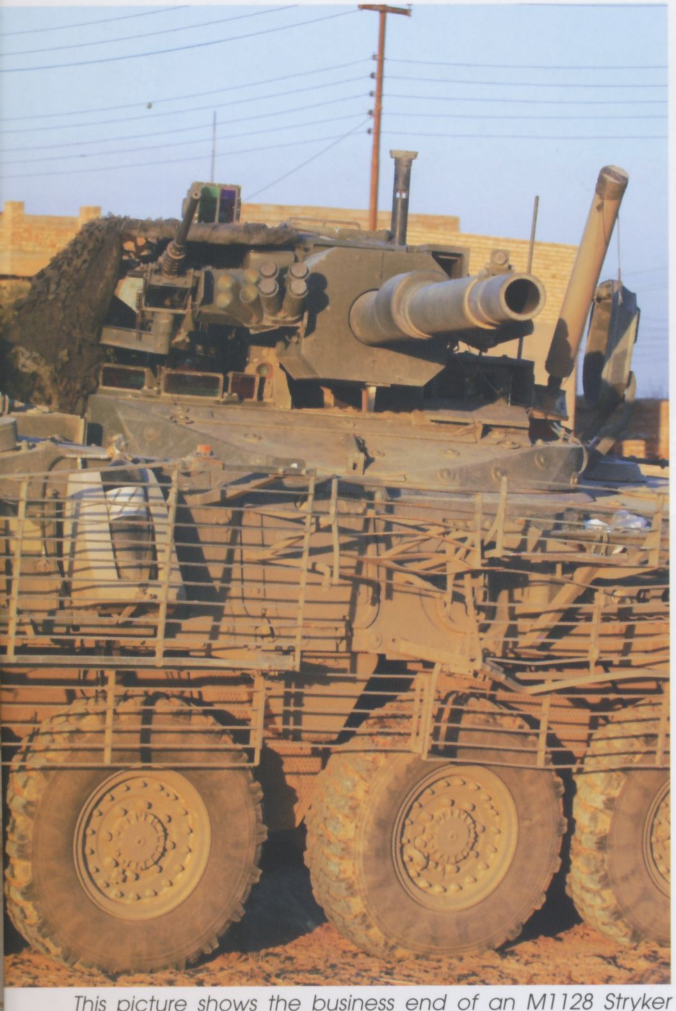
In front of the commander's cupola of this M1128 Stryker MGS is a 12.7mm M2 machinegun. This M1128 Stryker MGS is from A Company, 1st Battalion, 38th Infantry Regiment.

Constant improvements, combat losses and battle damage repair

Original Stryker variants did not feature any kind of add-on armor. When the first SBCT was earmarked to deploy to Iraq, a vehicle threat assessment identified a vulnerability to RPGs. Subsequently all Stryker IAV variants were fitted with slat standoff armor to counter the threat before deploying into Iraq. The armor consists of grill panels with horizontal bars, and is mounted some 400mm from the hull. When hit by an RPG, the slat armor deforms the warhead or causes it to detonate. In both cases the armor penetration capability of the warhead is reduced to such an extent that it is unlikely the Stryker hull will be penetrated.



In 2007 the M1128 Stryker MGS had its operational debut in Iraq. The M1128 was the last version of the Stryker family to enter service with the U.S. Army. It is fitted with a 105mm M68A1E4 rifled tank gun, coaxial 7.62mm M240 and 12.7mm M2 for the commander. Here an M1128 Stryker MGS can be seen during a patrol in Baqubah in January 2008.

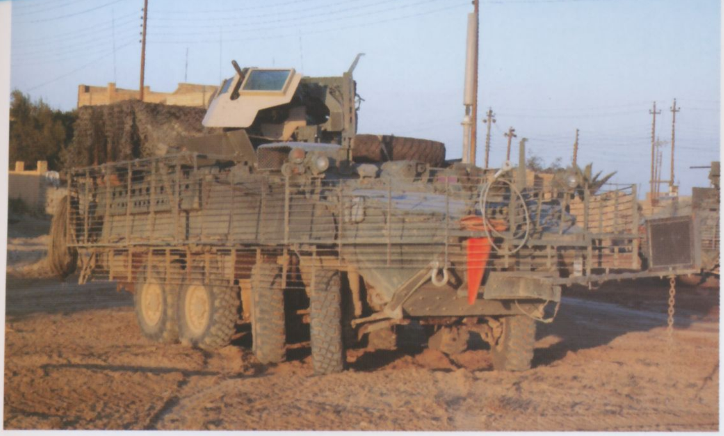


This picture shows the business end of an M1128 Stryker MGS, the same gun used in early variants of the M1 Abrams MBT. It can fire all 105mm NATO standard ammunition. The pictured vehicle belongs to A Company, 1st Battalion, 38th Infantry Regiment.

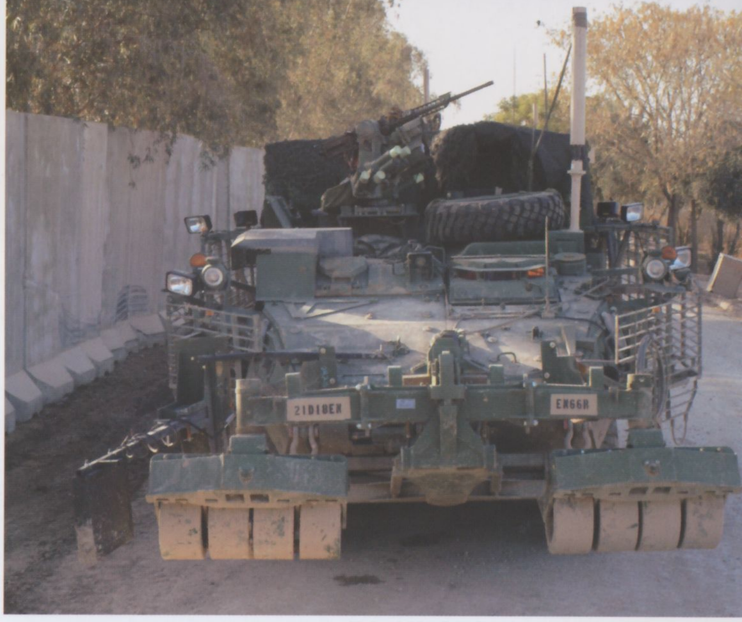
The full slat kit for a Stryker has a weight of some 2200kg, but fitting it also has disadvantages. The increased width of the vehicle means they can no longer be transported in a C-130 transport aircraft. In addition, handling vehicles in the narrow streets of the towns and cities of Iraq becomes tricky. When examining them closely, bends and dents can be found in the slat armor of most Stryker IAVs. The additional weight of the slat armor also altered the vehicle's center of gravity and increased the chance of a rollover. It also caused malfunctions of the tire inflation system in several cases. In addition, the dash speed is reduced. In order to replace the slat armor, a Stryker ERA suite was developed and entered service in 2006. However, so far the author has not seen any Stryker fitted with this ERA.

From 2004 onwards, Strykers deployed to Iraq were fitted with blast shields around the roof. In the beginning these blast shields were constructed of steel shields and boxes of sandbags constructed at the unit level. Later, industrial Blast Shield Kits were mounted on vehicles. These kits allow parts to be folded down and to be fitted with mounts for machinegun pintles. In order to counter the IED threat, Stryker IAVs were also fitted with Warlock and Rhino ECM systems. Around 2006, another modification was carried out at the unit level - in order to obscure the silhouettes of soldiers standing in the open air-guard hatches of the rear compartment, metal frames were mounted on vehicles and covered with camouflage netting. This unit-level modification became necessary after Stryker soldiers had been shot by insurgent snipers in several cases. In early 2007, Strykers of the 4th SBCT, 2nd Infantry Division, were seen sporting another unit-level modification, a dozer blade. Attached to recovery points on the front of the hull, the crude construction featured a strong metal blade lowered and lifted by operating the vehicle's self-recovery winch.

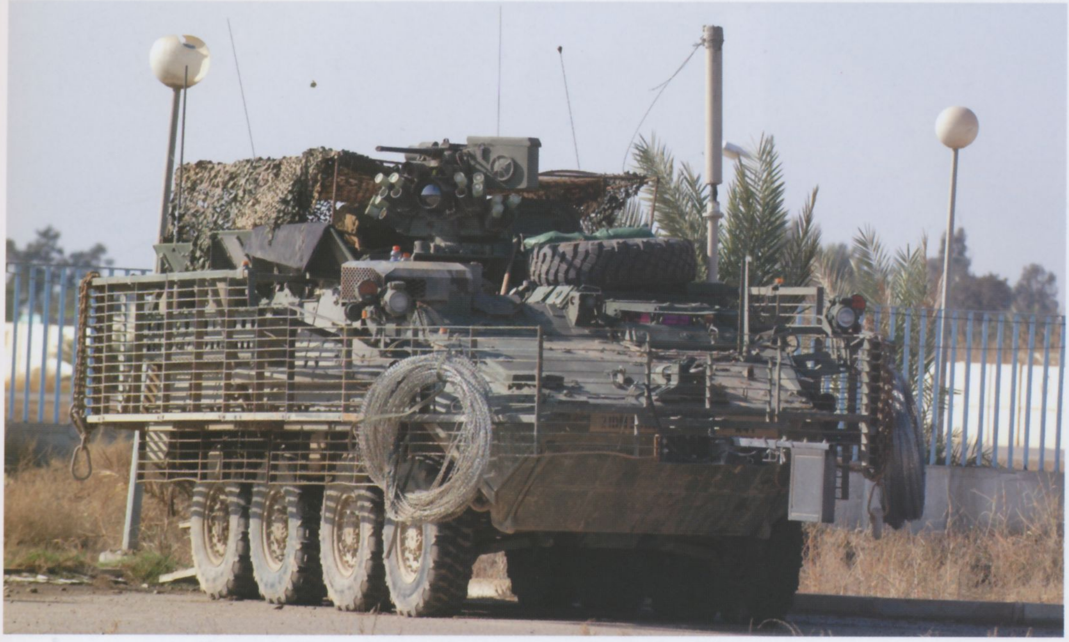
The Stryker vehicle fleet deployed to Iraq has been intensively used in combat operations. The first 300+ Strykers deployed in November 2003 were used by the 3rd Brigade, 2nd Infantry Division, for a year, and then handed over to the brigade's replacement, the 1st Brigade, 25th Infantry Division, which used them for a second year. During this period, the vehicles had an operational availability of 96% despite extensive wear and tear. Several vehicles were lost or damaged beyond repair by roadside bombs, VBIEDs or RPG hits. Even more vehicles suffered damage that could only be repaired by the manufacturer or in U.S. Army depots. As shipping vehicles back to the USA takes several weeks, this resulted in a reduction of vehicles available in the theater of operations. In 2006, in order to speed up the repair process, the TACOM Life Cycle Management Command awarded GDLS a contract for the repair of damaged Stryker IAVs to be carried out at the company's facility in Qatar. In this way, redeployment times for repaired vehicles were decreased significantly.



Each infantry company in an SBCT infantry battalion can field an M1131 Stryker FSV. Here the M1131 of A Company, 1st Battalion, 38th Infantry Regiment, is seen during an operation in southern Baqubah. Key equipment of the M1131 is the Fire Support Sensor System (FS3) Mission Equipment Package with attached laser designator module.



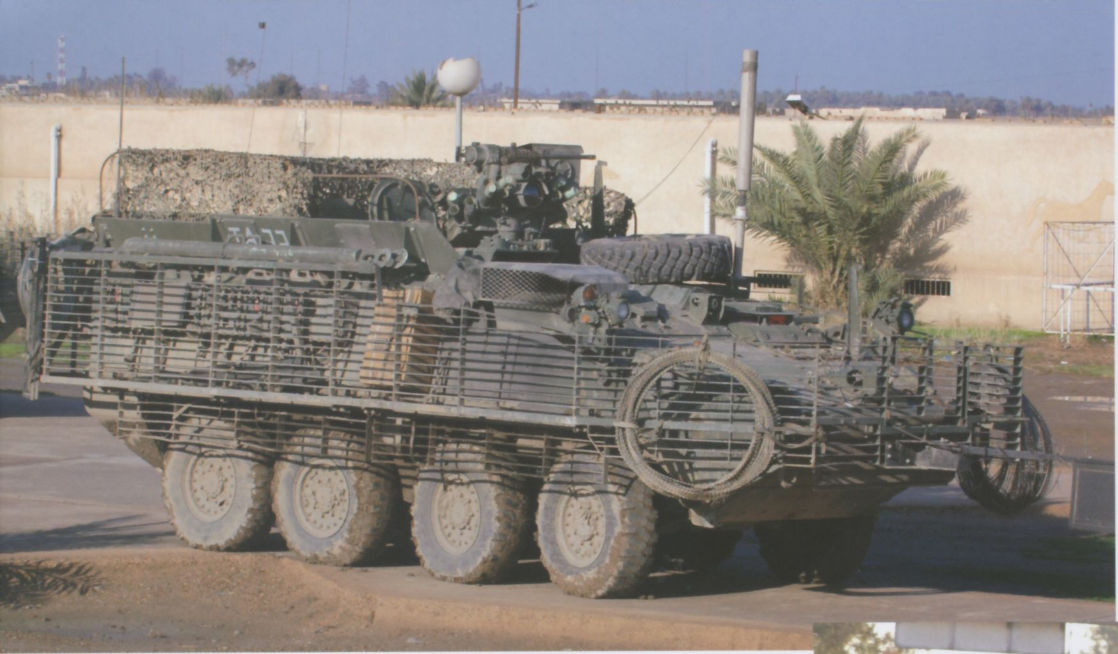
This M1132 Stryker ESV of the 18th Engineer Company is fitted with a Pearson Lightweight Mine Roller. The Lightweight Mine Roller is used to detonate and neutralize buried pressure-fused mines and other explosive devices. Note the Rhino and Warlock ECM systems, the DVE to the left of the driver's hatch, and the countless lights mounted on the vehicle for night patrols when the roadside has to be checked for hidden IEDs.



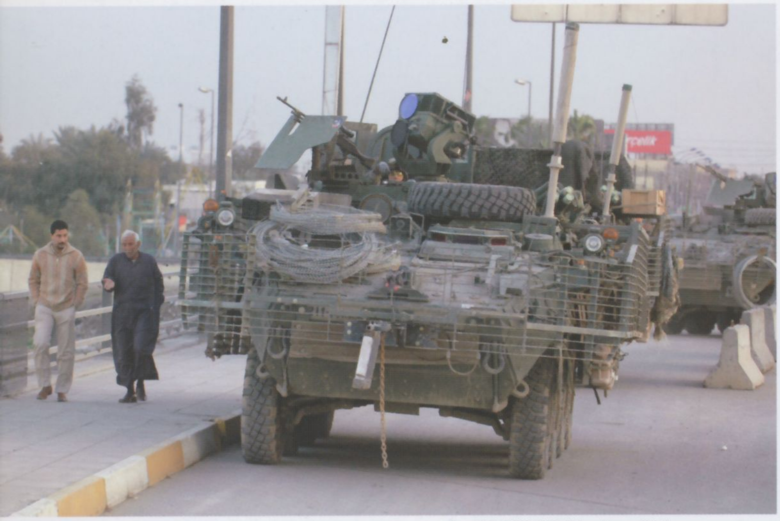
An M1126 Stryker ICV provides cover for dismounted troops during a search operation at the Baghdad Racecourse. The M151 RWS is fitted with a 12.7mm M2 machinegun. The vehicle belongs to the 1st Battalion, 23rd Infantry Regiment, and was seen in February 2007.

Technical Data for M1126 Stryker Infantry Carrier Vehicle

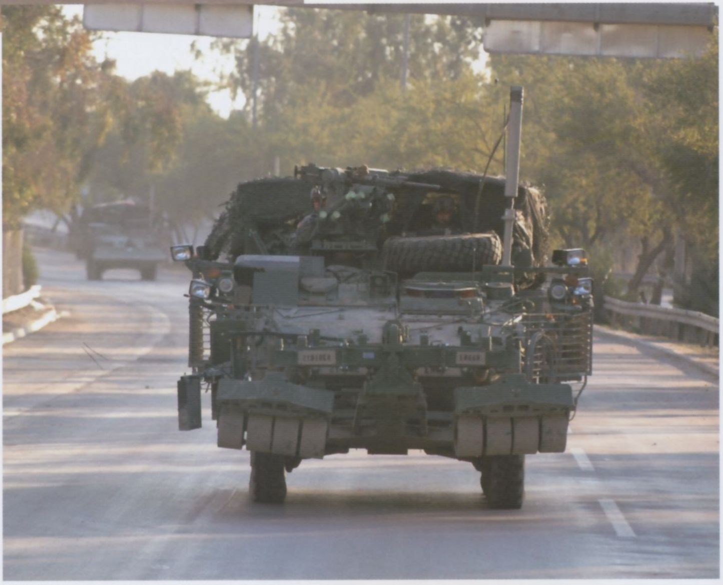
Crew:	2+9 (commander, driver and nine dismounts)
Combat weight:	18,300kg
Curb weight:	15,926kg
Overall length:	7.315m (without slat armor)
Overall width:	2.87m (without slat armor)
Overall height:	2.692m (without slat armor)
Engine:	7.2-litre Caterpillar 3126 I6 6-cylinder turbocharged JP8/diesel engine developing 350hp
Transmission:	Allison MD3066P automatic transmission with six forward and one reverse gears
Maximum speed:	101km/h
Fuel capacity:	200 liters
Operating range:	450km
Gradient:	60%
Side slope:	30%
Vertical obstacle:	600mm
Trench crossing:	2m
Fording:	1.3m
Armament:	1x 12.7mm M2 machinegun or 1x 40mm Mk19 MOD3 automatic grenade launcher mounted in the M151 Protector RWS 4x M6 66mm four-tube smoke discharger systems
Other systems:	CTIS, AN/VDR-2 Radiacmeter, M22 ACADA, M88 ACADA, Fire Suppression System, NBC Ventilating System, self-recovery capstan winch, AN/VAS-5 DVE, 1x AN/VRC-88F ASIP radio, 1x AN/VRC-91F ASIP radio, AN/UYK-128 FBCB2, AN/VSQ-2 (V) 1 EPLRS, ETM and AN/PSN-11 PLGR (or its replacement, the DAGR).



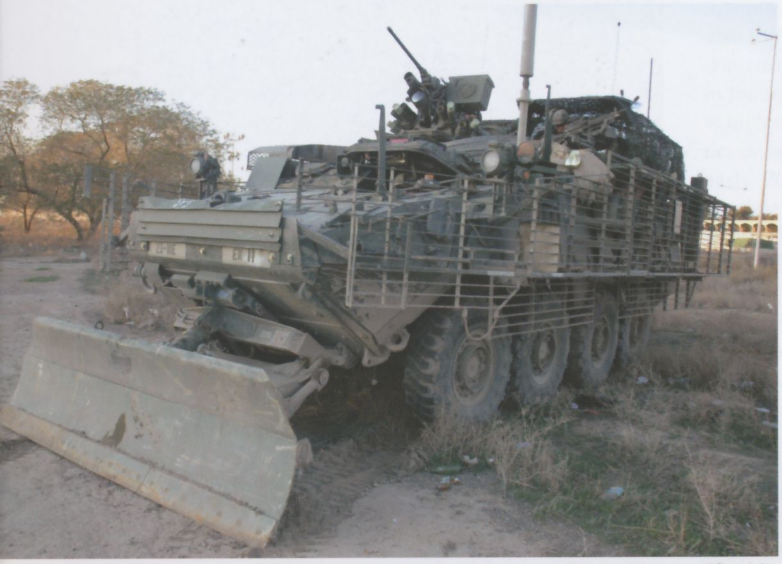
Since the Stryker entered service, countless modifications have been carried out to adapt the vehicle to fighting in Iraq. Some major improvements can be spotted on this Stryker ICV of the 1st Battalion, 23rd Infantry Regiment, seen in Baghdad in early 2007. The most obvious is the slat stand-off armor. Other modifications include Warlock and Rhino ECM systems.



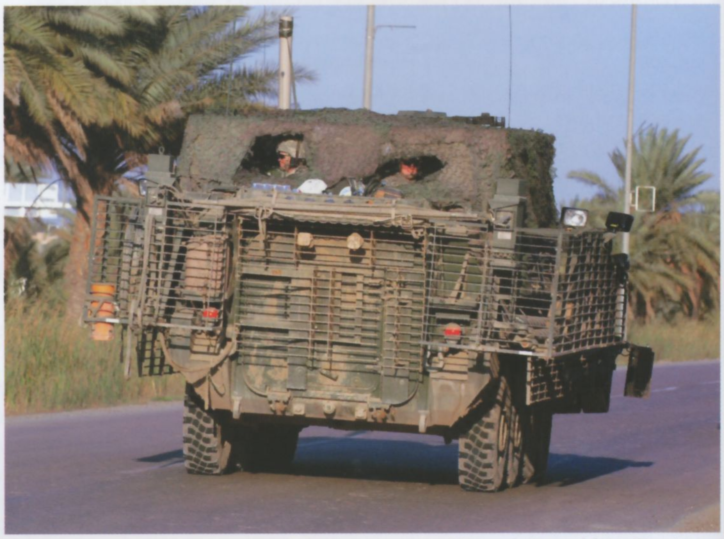
In February 2007 this patrol composed of M1127 Stryker RVs was seen in Baghdad. The vehicles belong to the 1st Squadron, 14th Cavalry Regiment. While the M1127 Stryker RV and M1131 Stryker FSV look similar, they differ in their reconnaissance and surveillance equipment. The sensor system of the M1127 Stryker RV is the LRAS3.



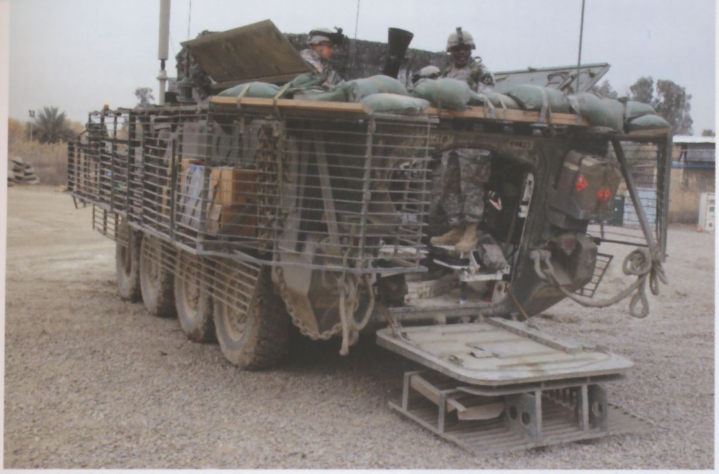
A convoy of M1132 Stryker ESVs of the 18th Engineer Company thunders down Road Irish heading for the Green Zone in the center of Baghdad in March 2007. The first Stryker is fitted with a Lightweight Mine Roller, the second with a Surface Obstacle Blade.



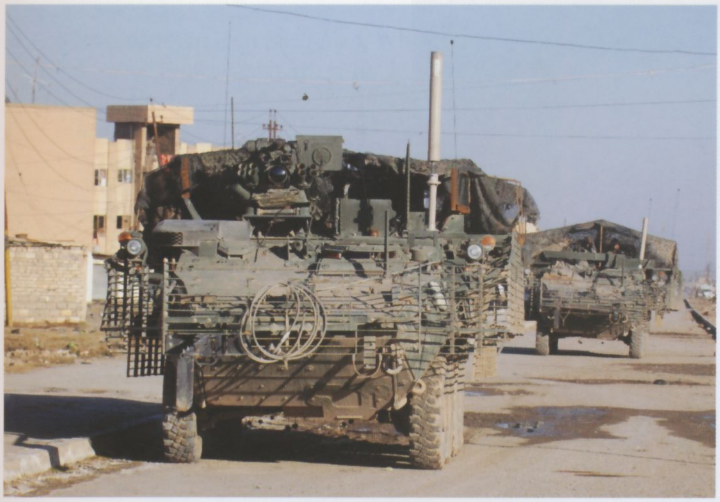
The M1132 Stryker ESV is nearly identical to the ICV, but is modified to carry specific engineer equipment. Mine-clearing devices such as a Surface Mine Plow, Lightweight Mine Roller or Angled Mine Plow can be fitted to the front of the vehicle. The pictured vehicle of the 18th Engineer Company has been fitted with a Surface Obstacle Blade.



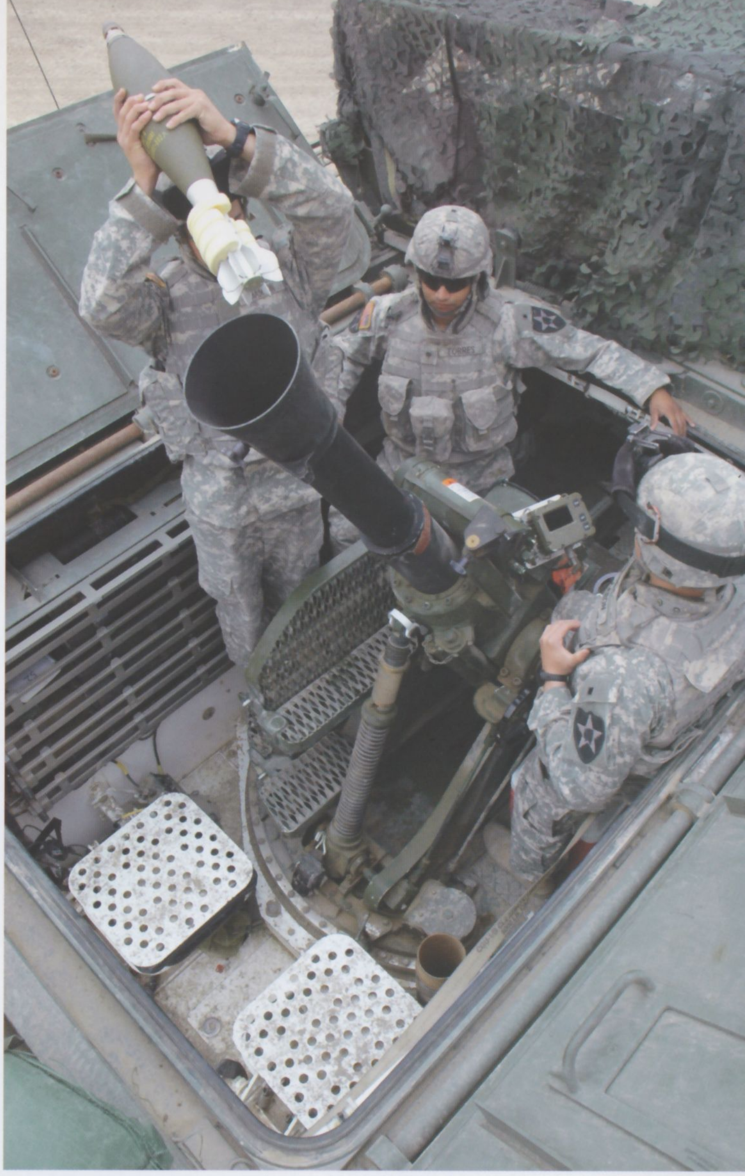
This rear view shows an M1132 Stryker ESV of the 18th Engineer Company on patrol in Baghdad in March 2007. Apparent are the Lane Marking Equipment dispenser units mounted at the left and right rear corners. The system is used to mark cleared lanes in a minefield with 1m-long marker poles. The poles are shot into the ground using pressurized air. Each dispenser unit can hold up to 50 marking poles.



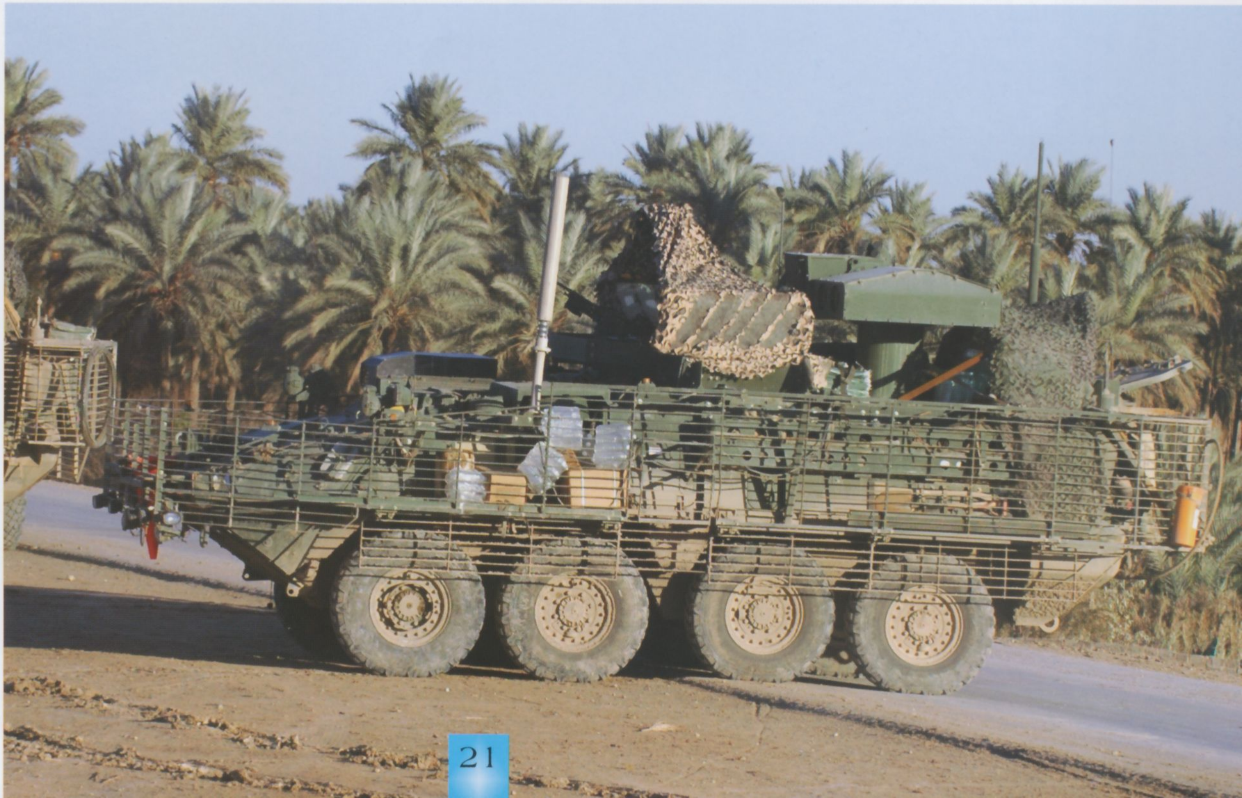
The M1129 Stryker MC-B has a combat weight of 18,764kg. In the rear compartment is a 120mm RMS6-L. In addition, either a 60mm M224 or 81mm M252 mortar is carried inside for dismounted operations. This example belongs to the 1st Battalion, 23rd Infantry Regiment, and was seen in a firing position at Camp Victory in Baghdad in March 2007.



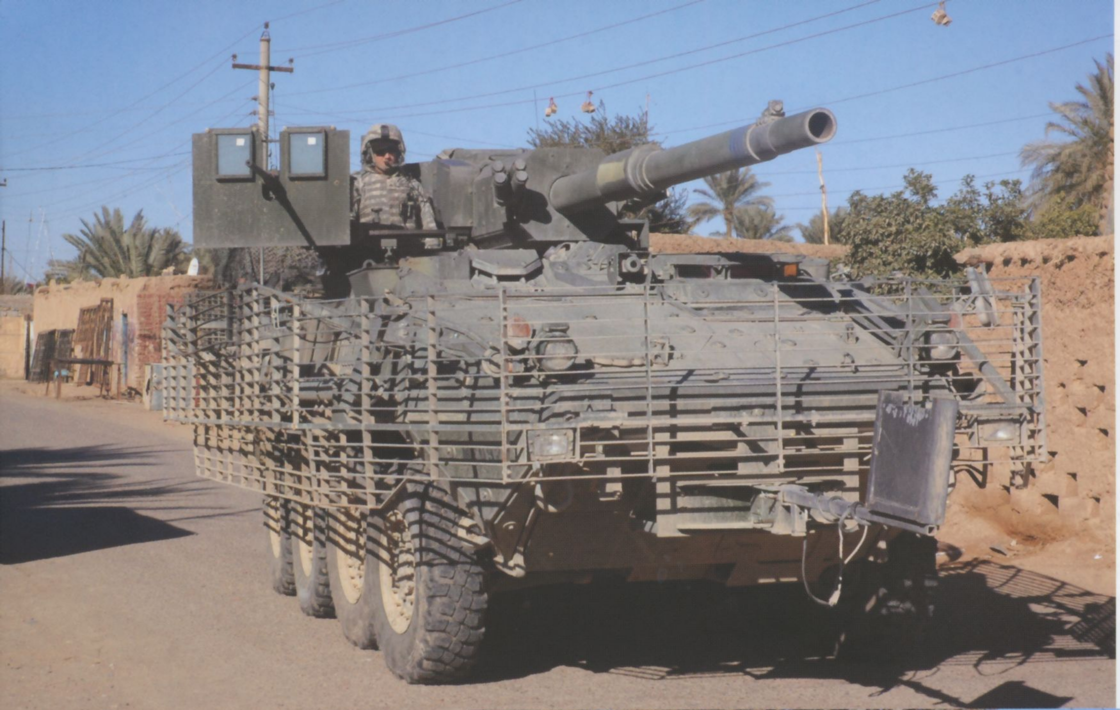
January 2008: Strykers of A Company, 1st Battalion, 38th Infantry Regiment, patrol in the city of Baqubah. The first vehicle is an M1126 Stryker ICV while the second is an M1129 Stryker MC-B. Note that the ICV is fitted with an M151 Protector RWS while the M1129 is not.



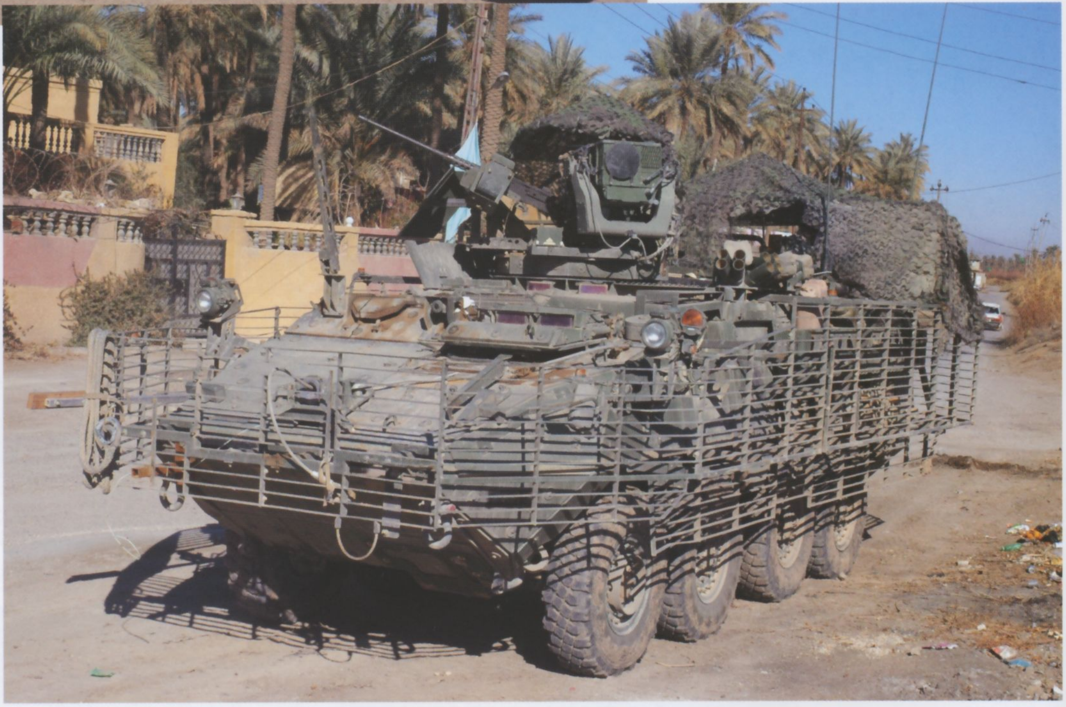
The main weapon system of the M1129 Stryker MC-B is the 120mm RMS6-L. The mortar is mounted on a 4400-mills traversable base plate in the rear fighting compartment. With conventional ammunition, the weapon has a maximum range of 6700m.



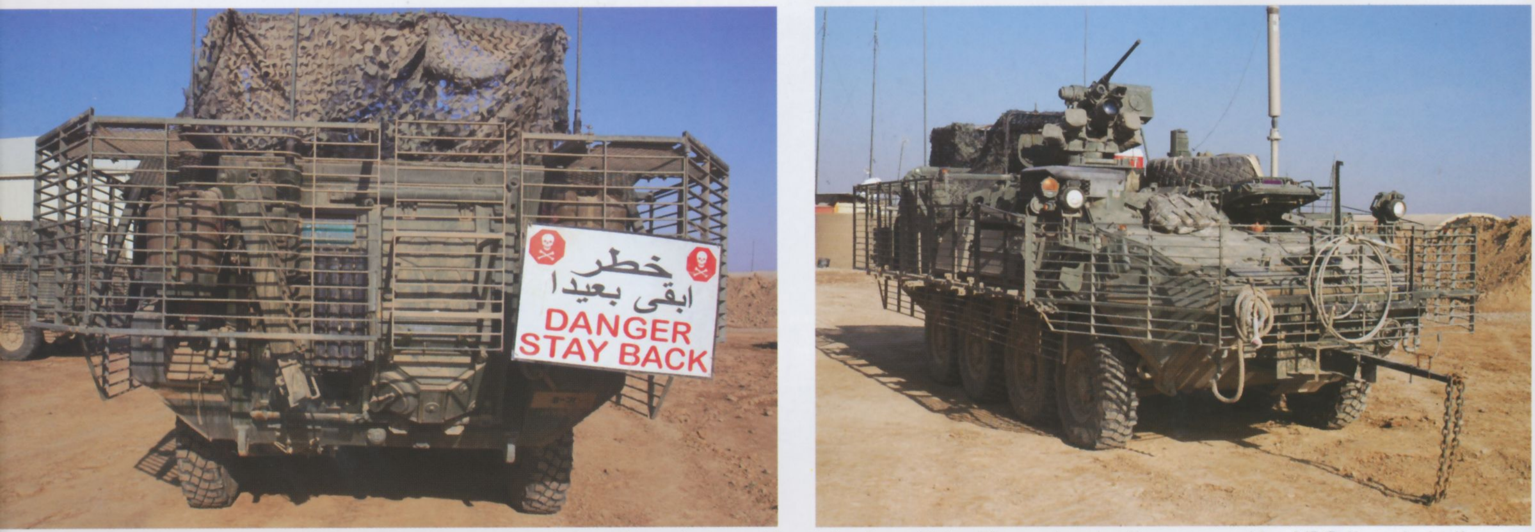
The anti-armor company of an SBCT can field nine M1134 Stryker ATGM vehicles. Here an M1134 of F Company, 52nd Infantry Regiment (the anti-armor company of the 4th SBCT, 2nd Infantry Division), can be seen in Baqubah in January 2008. Visible is the ETS incorporating twin TOW launch tubes and the Modified Improved Target Acquisition System.



Each infantry company within an SBCT can field a platoon with three M1128 Stryker MGSs. The M1128 MGS without slat armor is 7.315m long, 2.87m wide and 2.692m high. The vehicle has a combat weight of 19,051kg when 18 rounds for the 105mm M68A1E4 rifled gun are stowed. This MGS belongs to A Company, 1st Battalion, 38th Armor Regiment, and was seen in a small village north of Baqubah. Note the Gunner Shield mounted by the commander's machinegun.



This M1131 Stryker FSV of the 4th SBCT, 2nd Infantry Division, was seen during a patrol north of Baqubah in January 2007. Like all other Strykers, it is fitted with the slat armor that is nicknamed "bird cage" by troops. The FSV crew consists of a driver and commander (the latter operates the FS3 Mission Equipment Package) plus two more crewmembers.



The M1135 Stryker NBCRV is basically a mobile laboratory designed to detect and identify contamination caused by NBC threats. In the rear compartment is a comprehensive sensor suite including a CBMS Block II, JBPDS, Lightweight SCAD, CVSS, and Double Wheel Sampling System. This vehicle of the Reconnaissance Platoon, 2nd Squadron, 1st Cavalry Regiment, was seen at Camp Warhorse in Baqubah in January 2008

M109A6 Paladin Self-Propelled Howitzer

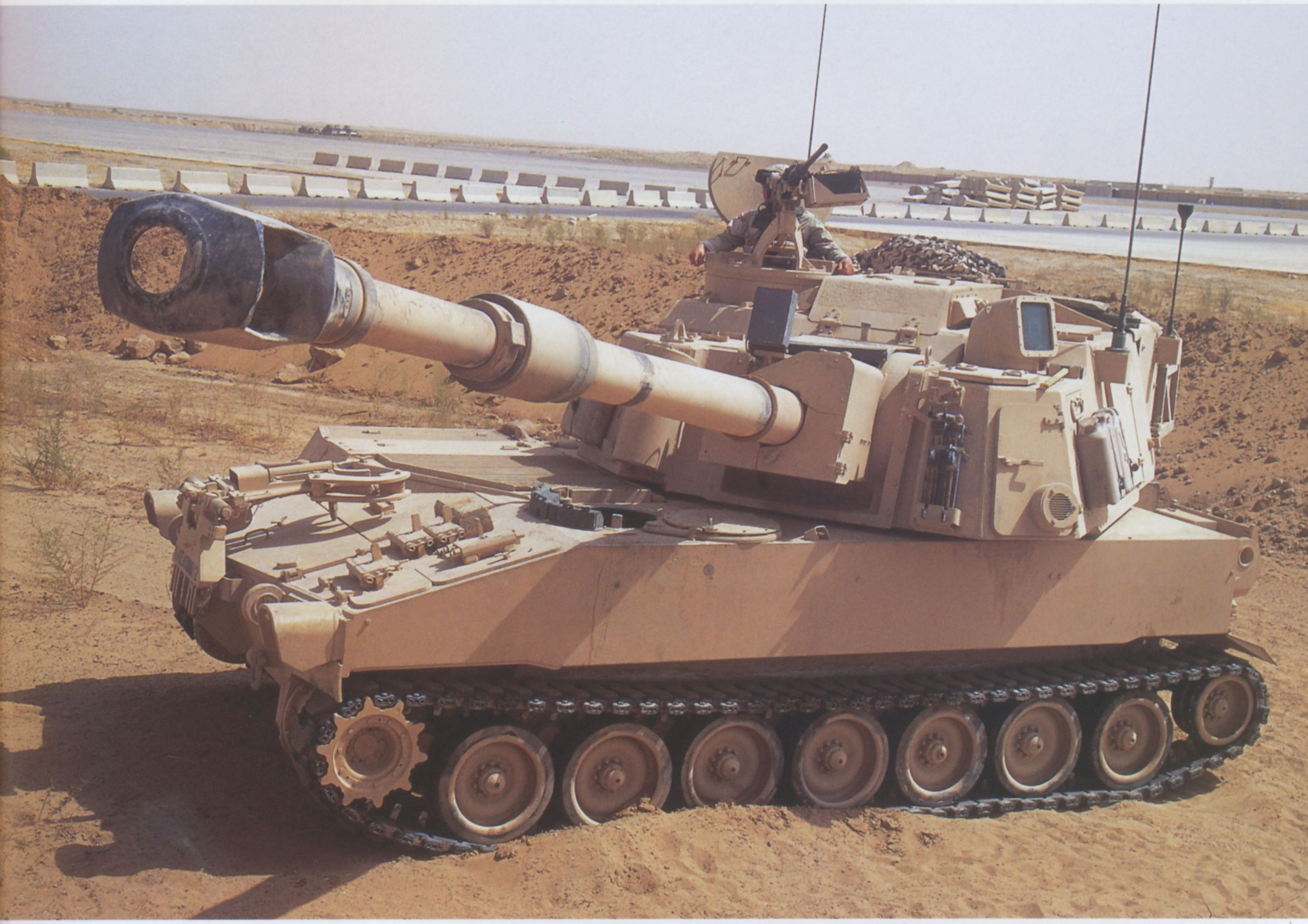
The 155mm M109A6 Paladin self-propelled howitzer is the primary indirect fire support system of the U.S. Army. Under the army's Task Force organization, a field artillery battalion with three gun batteries of six M109A6s supports a heavy brigade. The M109A6 is the most modern version of a vehicle originally designed in the 1950s, and which first entered service in the early 1960s. Since then the M109 has undergone several modernization programs, the last being the Howitzer Improvement Program initiated in 1985. In 1990, series production of the M109A6 began, which was in fact a recapitalization of older variants.

The first M109A6 entered service with field artillery battalions in 1992. Up till the end of 2004, a total of 975 M109A6s were fielded with units of the U.S. Army and ANG. The tracked, armor-protected M109A6 is fitted with an M284 howitzer fitted in an M182A1 mount in the turret. With standard ammunition such as the M107 High Explosive projectile or M116A1 Smoke projectile, the M109A6 has a firing range of 22km. The M109A6 can also fire the laser-guided M712 High Explosive Anti-Tank "Copperhead" round. Stationary or moving hard targets can be engaged out to a distance of 16km with this round. When an M549A1 High Explosive Rocket-Assisted Projectile (RAP) is fired, the range is increased to 30km. From 2005 onwards, the army began modifying serving M109A6s to allow use of the Modular Artillery Charge System and firing of the XM982 Excalibur GPS precision-guided extended-range family of artillery projectiles to engage targets out to a range of 40km. On 5 May 2007, for the first time ever, an XM982 Excalibur projectile was fired in an operational theater. The projectile aimed at an insurgent safe house was fired by an M109A6 of the 1st Battalion, 82nd Field Artillery Regiment, stationed at Camp Taji.

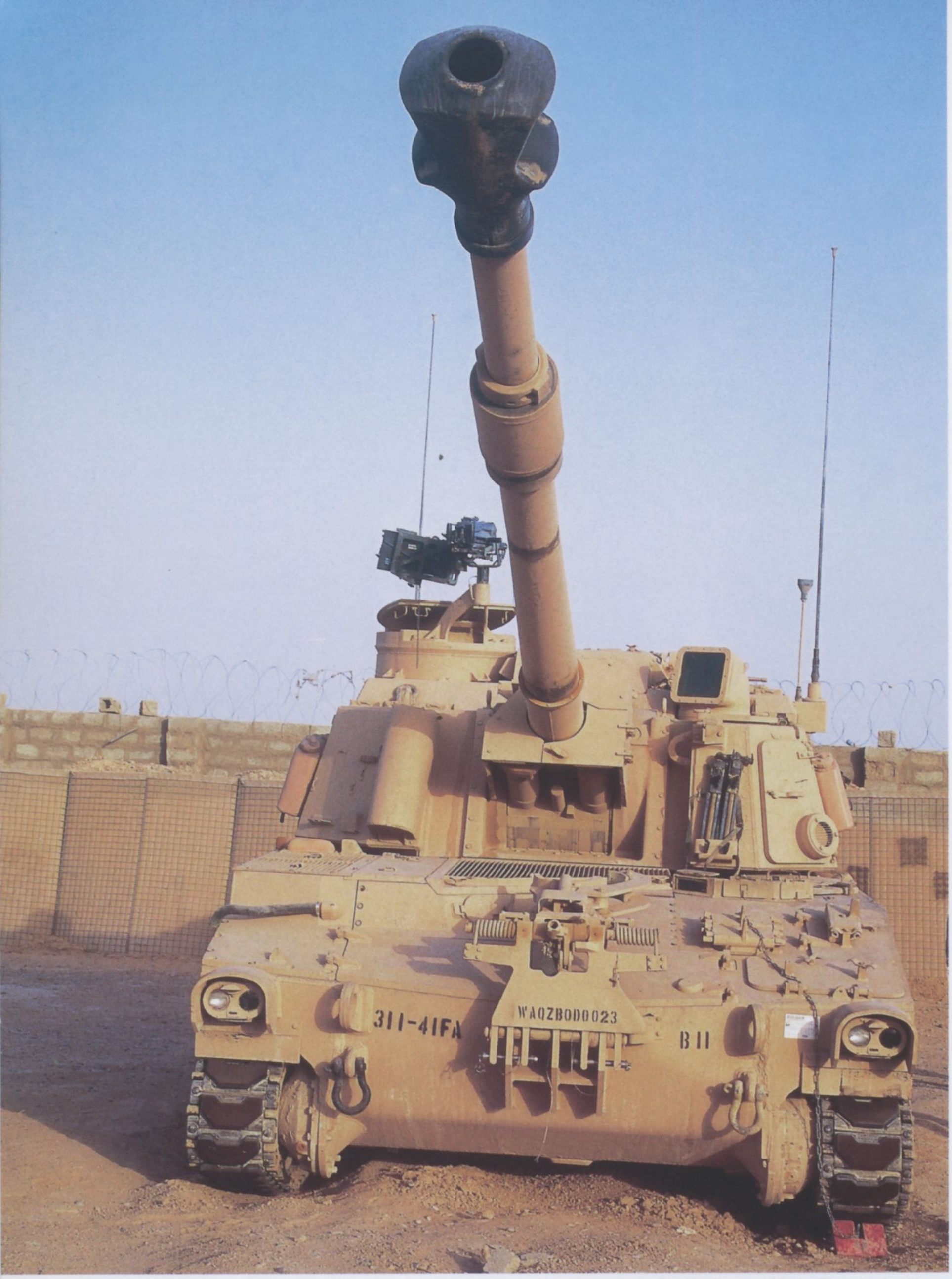
Among its state-of-the-art technologies, the M109A6 features a power-assisted semi-automatic loading system, onboard Automatic Fire Control System, GPS-based navigation system, ASIP radios that allow receiving of digital fire commands, computer-controlled gun drive and traverse system, NBC protection system, Microclimate Cooling System, passive night vision for the driver, and remotely operated barrel travel lock. The self-propelled howitzer can operate in the shoot-and-scoot mode in order to minimize danger from counter-battery fire. When deploying into a firing position, the M109A6 is able to fire the first round within 45 seconds of its arrival. The ammunition combat load of an M109A6 includes 37 conventional 155mm rounds (a mix of HE, Smoke and Illumination) and two 155mm M712 Copperhead Cannon-Launched Guided Projectiles.

M992A2 Field Artillery Ammunition Supply Vehicle

The M992A2 Field Artillery Ammunition Supply Vehicle (FAASV) is based on the same chassis as the M109A6. Like the self-propelled howitzer, it is powered by a Detroit Diesel 8V71T eight-cylinder turbocharged diesel engine that develops 440hp at 2300rpm. It also uses the same Allison XTG-411-4A transmission featuring four forward and two reverse gears. Instead



The 155mm M109A6 Paladin self-propelled howitzer, fitted with a 155mm M284 cannon in an M182A1 gun mount, is currently the only artillery weapon system of its kind in service with the U.S. Army. The gun uses a three-part ammunition system consisting of a projectile, propellant charge and cartridge-type primer. The pictured M109A6 belongs to A Battery, 1st Battalion, 41st Field Artillery Regiment, and was seen at Camp Summerall in July 2005.



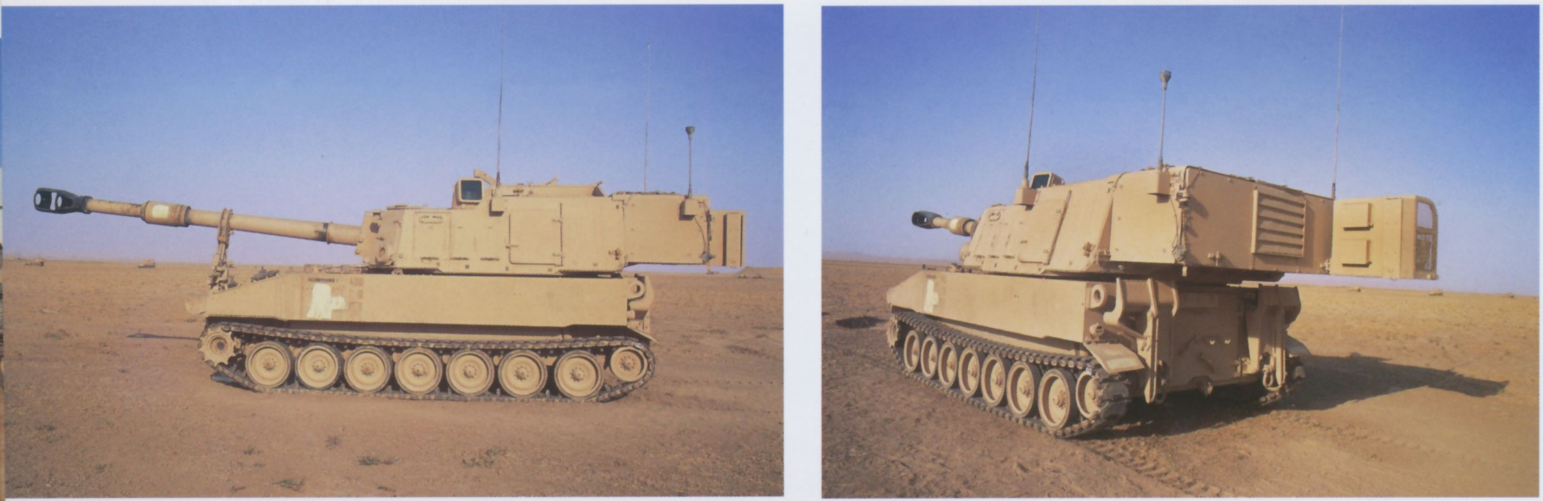
This 155mm M109A6 Paladin also belongs to the 1st Battalion, 41st Field Artillery Regiment, but this time to B Battery. In the summer of 2005 it was based at FOB Brassfield-Mora outside Samarra. With standard ammunition such as an M107 High Explosive projectile, the M109A6 has a firing range of 22km.

of a gun turret, the FAASV is fitted with a large armored superstructure that houses 90 conventional 155mm projectiles, three M712 Copperhead projectiles and 99 charge containers, plus fuses and primer cartridges. When loaded, the M992A2 FAASV has a combat weight of 26,105kg. It is 6.604m long, 3.15m wide and 3.632m high. Ammunition can be moved from the M992 FAASV to the M109A6 via a power-operated conveyor belt situated in the rear of the vehicle. This means a self-propelled howitzer can be bombed up without a crewmember of either the M992A2 or M109A6 having to leave the armored protection of their vehicles. The U.S. Army fields a total of 927 M992A2s. The first M992 FAASV entered service in 1984, and over the years they have been upgraded to the current A2 standard.

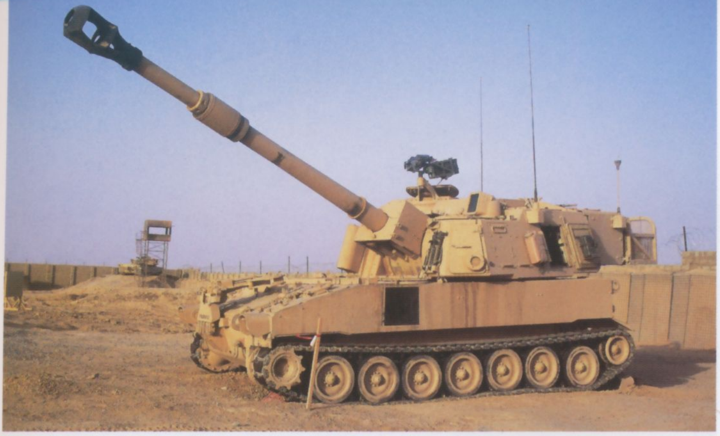
Firing every single day

While the first M109s had their combat debut during the Vietnam War, the M109A6 had its true baptism of fire in OIF in 2003. During the initial ground war, deployed gun batteries performed well, mostly achieving fire-mission times of less than two minutes during direct-support missions. They fired thousands of rounds, and along with rocket launchers and combat aircraft, literally pulverized Iraqi resistance. At the same time, according to a Lessons Learned Report of the 3rd Infantry Division, their fire was very accurate and crews achieved a high operational readiness rate. It was also stated the M109A6 offered crews adequate armor protection.

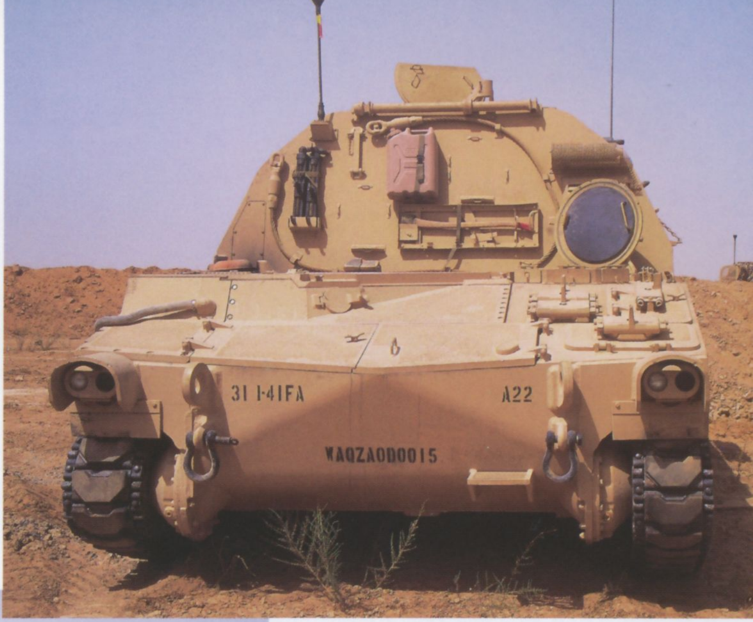
The M109A6 was also kept busy when the insurgency started. Again these self-propelled howitzers have conducted hundreds of fire missions in support of ground combat operations - they aid ground troops during night operations by lighting up the sky with illumination rounds, engage insurgent positions with HE projectiles where accuracy rather than quantity is required, and in order to prevent collateral damage, they fire precision-guided projectiles. The M109A6 has been used continually to provide indirect fire support to U.S. forces since the insurgency kicked off in late 2003. In January 2008 when the author was most recently in Baqubah at Forward Operating Base (FOB) Warhorse, a gun battery was firing illumination and terrain-denial missions every single night over a weeklong period.



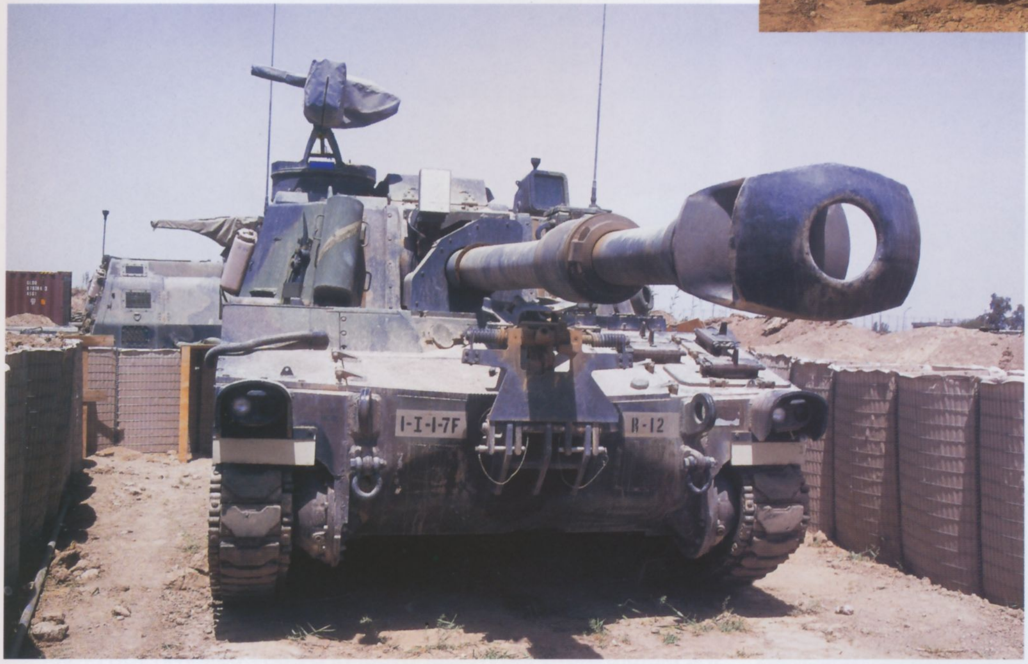
In August 2005 this M109A6 of Howitzer Battery "Lion" of the 2nd Squadron, 3rd Armored Cavalry Regiment, was seen deployed in a firing position at Tall Afar Airbase. Only hours later this gun, together with the five others in the battery, fired several hundred rounds in support of a large-scale counterinsurgency operation conducted in the southern outskirts of the insurgent-plagued city of Tall Afar. Note that one of the vehicle's external turret baskets is missing. Visible is the travel lock that is usually released shortly before a fire mission, and which provides support for the 155mm M284 gun tube during movements.



The main armament of the M109A6 Paladin is the 155mm M284 cannon. The cannon features a large 159kg muzzle and the barrel is 6m long. The M109A6 can fire for three minutes at a rate of four rounds per minute. The pictured M109A6 belongs to the 1st Battalion, 41st Field Artillery, and was seen in July 2005.



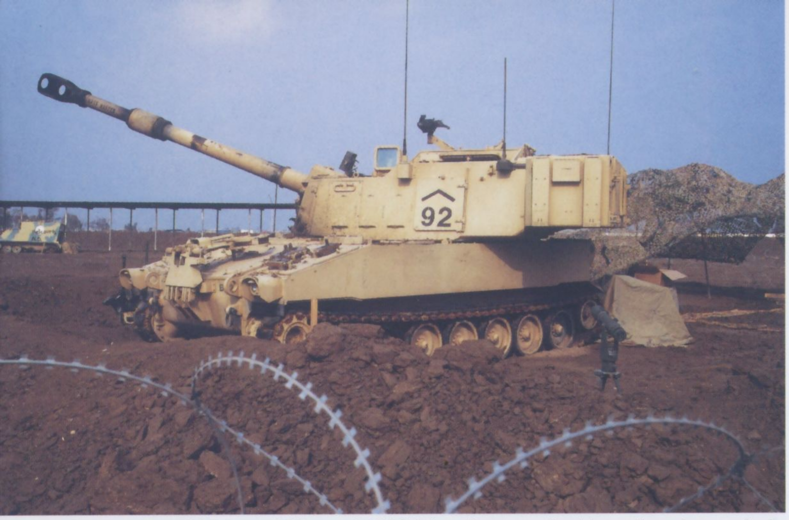
Additional ammunition for the M109A6 Paladin is carried by the M992A2 FAASV. Based on the same chassis as the M109A6, it features a large raised rear compartment in which spare ammunition is carried. During operations, every M109A6 is accompanied by an M992A2 FAASV. The pictured vehicle belongs to A Battery, 1st Battalion, 41st Field Artillery Regiment, at Camp Summerall in August 2005.



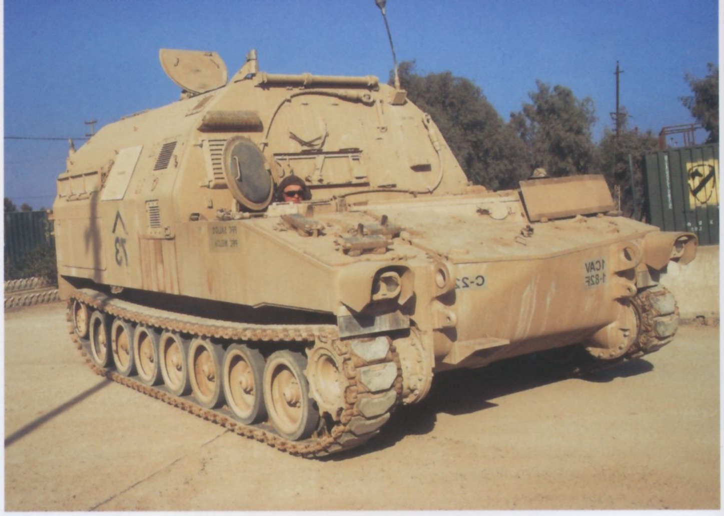
This picture shows a 155mm M109A6 Paladin of the 1st Battalion, 7th Field Artillery Regiment, at FOB Paliwoda in June 2004. Despite the fact that the gun is operating in a desert environment, it is still painted in the standard NATO three-color camouflage. During the Iraq insurgency, the army did not usually bother repainting vehicles in a desert camouflage pattern.

Technical Data for M109A6 Paladin

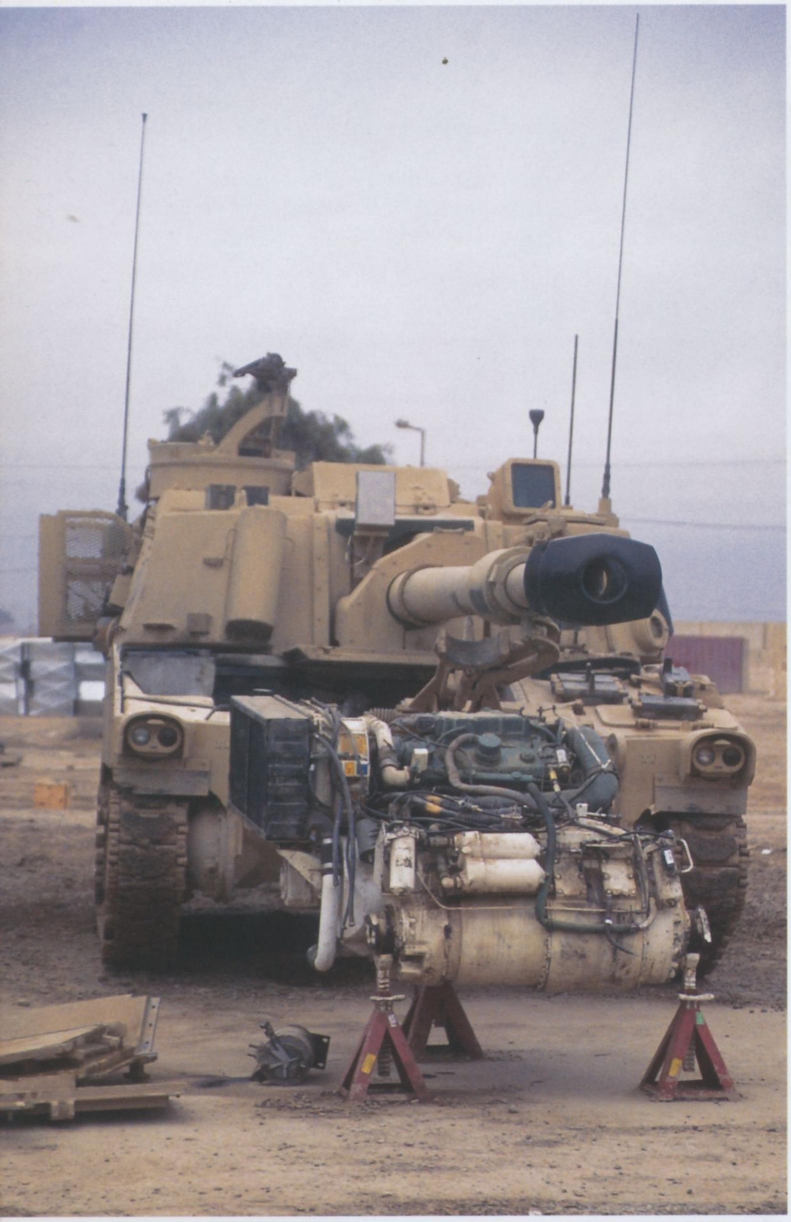
Combat weight:	28,881kg
Crew:	4 (section chief, driver, gunner and cannoneer)
Length:	10.7m (with basket to the rear)
Height:	3.63m
Width:	3.3m
Maximum speed:	61km/h
Cruising range:	299km
Fuel tank capacity:	503 liters
Turning radius:	one vehicle length
Gradient:	60%
Fording:	1.07m
Trench crossing:	1.83m
Vertical obstacle:	530mm
Engine:	Detroit Diesel 8V71T 8-cylinder turbocharged diesel engine developing 440hp at 2300rpm
Transmission:	Allison XTG-411-4A transmission, four forward and two reverse gears
Armament:	1x 155mm M284 cannon in M182A1 gun mount, 1x 12.7mm M2 machinegun or 40mm Mk19 MOD3 automatic grenade launcher for close defense
Ammunition:	39 155mm projectiles and 44 propelling charges
Other systems:	Automatic/Remote Gun Tube Travel Lock, PLGR, Satellite Signals Navigation Set AN/PSN-11, Microclimate Conditioning System, Vehicle Motion Sensor, Automatic Fire Control System, Muzzle Velocity System, Prognostic/Diagnostic Interface Unit, Dynamic Reference Unit Hybrid, NBC-protection system, Power Conditioner Unit, Elevation and Azimuth Tachometer
Manufacturer:	United Defense LP (today BAE Systems)



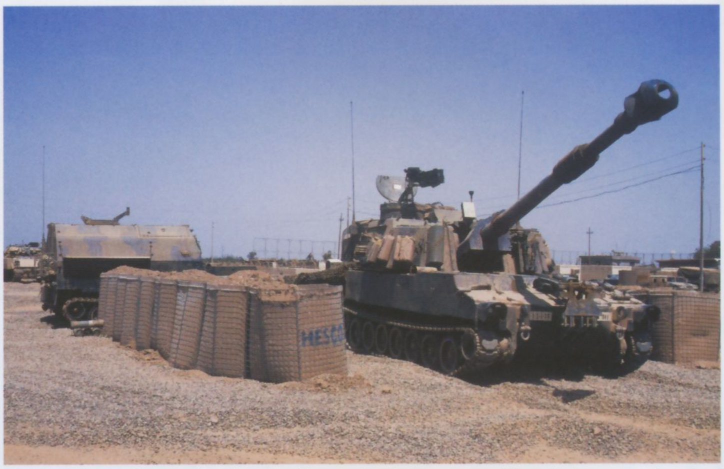
December 2004 - a 155mm M109A6 self-propelled howitzer is ready to conduct a counter-battery fire mission. Note the markings of the Combat Vehicle Marking System on the side of the turret, and the nickname "Bass Master" on the cannon tube. This Paladin belongs to B Battery, 2nd Battalion, 82nd Field Artillery Regiment.



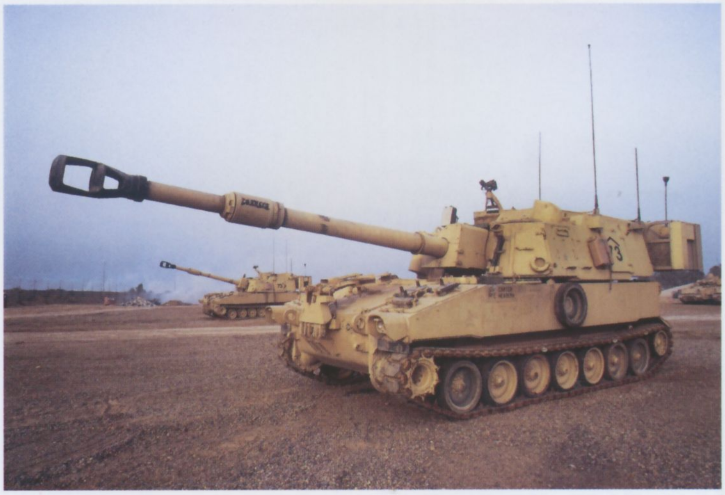
The M992A2 FAASV has a combat weight of 26,105kg, and is 6.604m long, 3.15m wide and 3.632m high. The M992A2 FAASV is powered by an 8V71T diesel engine that develops 405hp at 2300rpm. The vehicle can reach a top speed of 56km/h, and with a full tank of 511 liters, it achieves a range of 353km. The pictured M992A2 belongs to the 3rd Armored Cavalry Regiment, and was seen in a firing position at Tall Afar Airbase in August 2005.



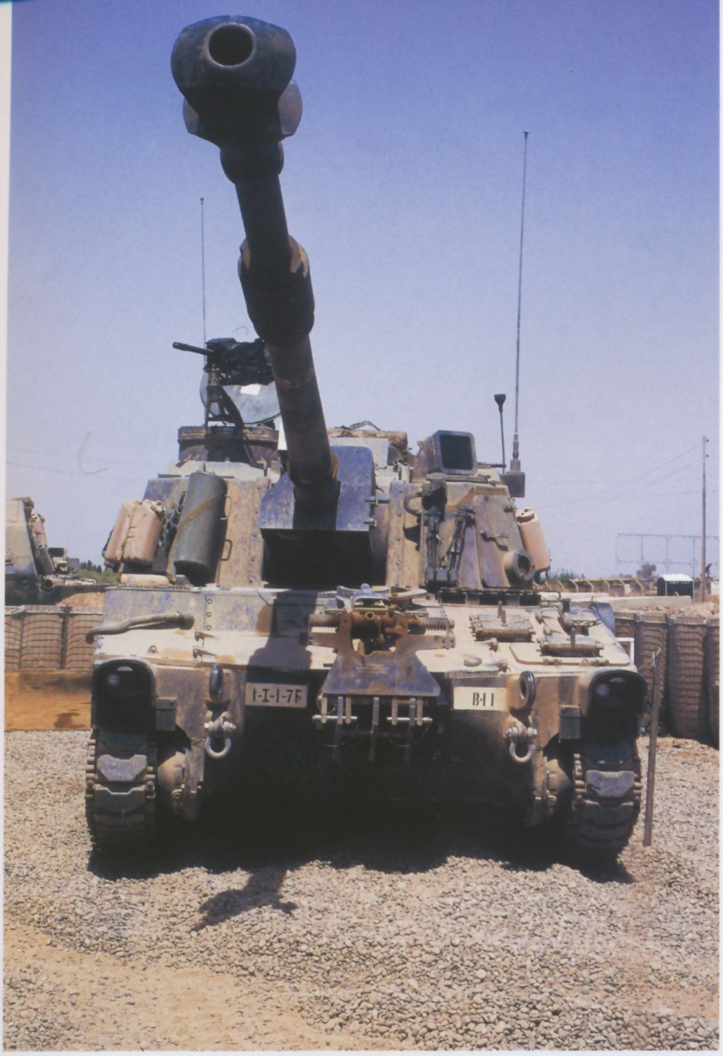
The 155mm M109A6 is powered by a Detroit Diesel 8V71T eight-cylinder turbocharged diesel engine mounted in the front right of the hull. Here it can be seen removed for maintenance purposes. This M109A6 belongs to C "Rock" Battery, 1st Battalion, 82nd Field Artillery Regiment, and it was seen at FOB Eagle in Baghdad in December 2004.



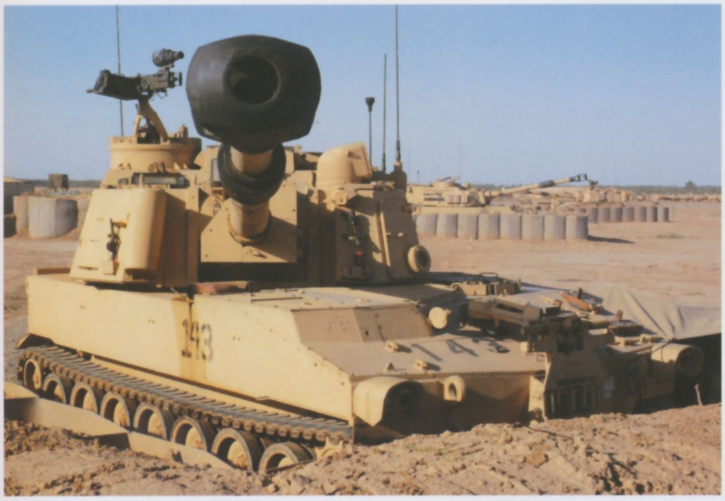
The picture shows the typical layout of a gun position in Iraq protected by lines of HESCO barriers. The photo was taken at FOB Paliwoda in Balad in June 2004. The howitzer and accompanying M992A2 FAASV belong to the 1st Battalion, 7th Field Artillery Regiment.



On 29 September 2004, these two M109A6 howitzers of C "Rock" Battery, 1st Battalion, 82nd Field Artillery Regiment, wreaked havoc on an insurgent mortar team that had repeatedly mortared FOB Eagle in Baghdad. Counter-battery fire missions are among the primary tasks of self-propelled howitzers in Iraq.

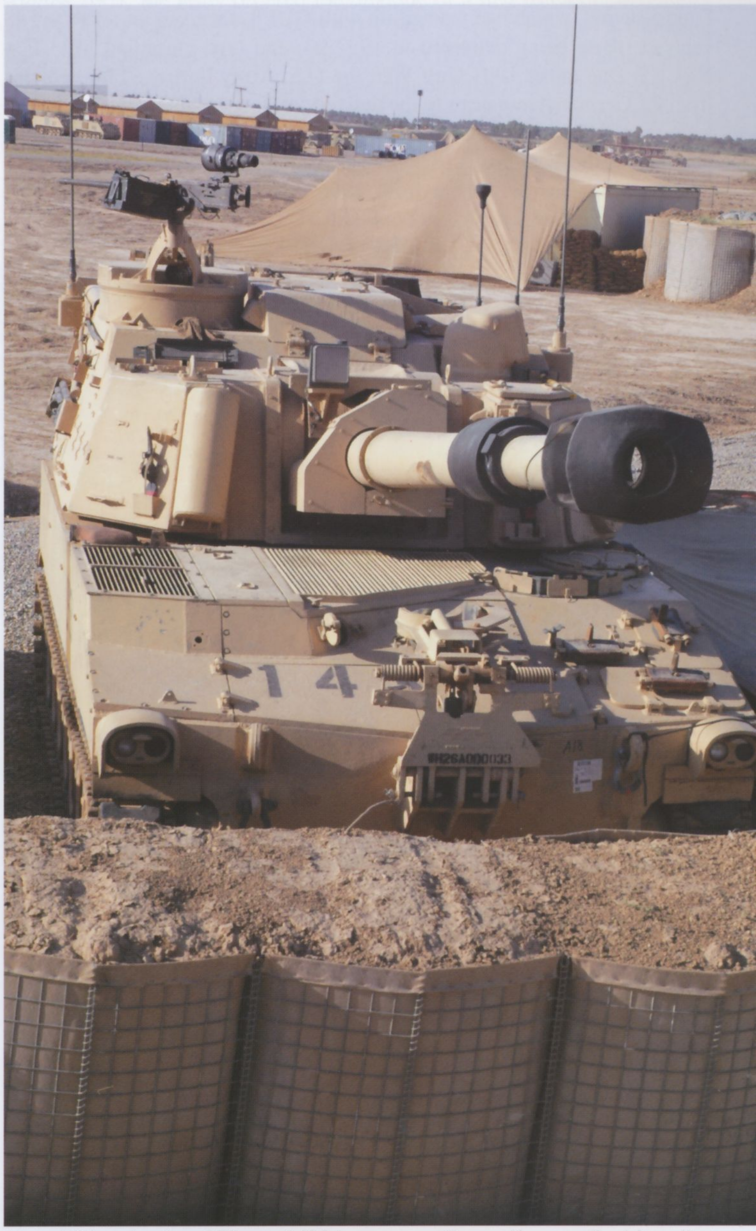


The driver is seated at the front left of the hull while the turret with 155mm M284 cannon is mounted at the rear. In the turret the section chief is seated on the right, while the gunner and cannoneer are positioned on the left. Here an M109A6 Paladin of the 1st Battalion, 7th Field Artillery Regiment, can be seen in 2004.



June 2006: FOB Warhorse outside Baqubah. M109A6 howitzers have been deployed in a standard firebase layout. Note the three visible guns each face a different point of the compass. A battery deployed in this way can engage targets within a 360° diameter of 44km in the shortest possible time. These guns belong to the 3rd Battalion, 29th Field Artillery Regiment.

Since the end of the initial invasion, M106A6 Paladins have fired thousands of rounds as part of counter-battery fire missions targeting insurgents that have attacked American bases with indirect fire. Here an M109A6 of the 1st Battalion, 7th Field Artillery Regiment, based at FOB Summerall, can be seen firing during a terrain-denial mission in June 2004.



In addition to the 155mm M284 cannon, the self-propelled howitzer features a pintle-mounted 12.7mm M2 machinegun mounted at the commander's cupola for close-protection purposes. This weapon can rotate a full 360°. The pictured M109A6 was seen in Baqubah in June 2006.

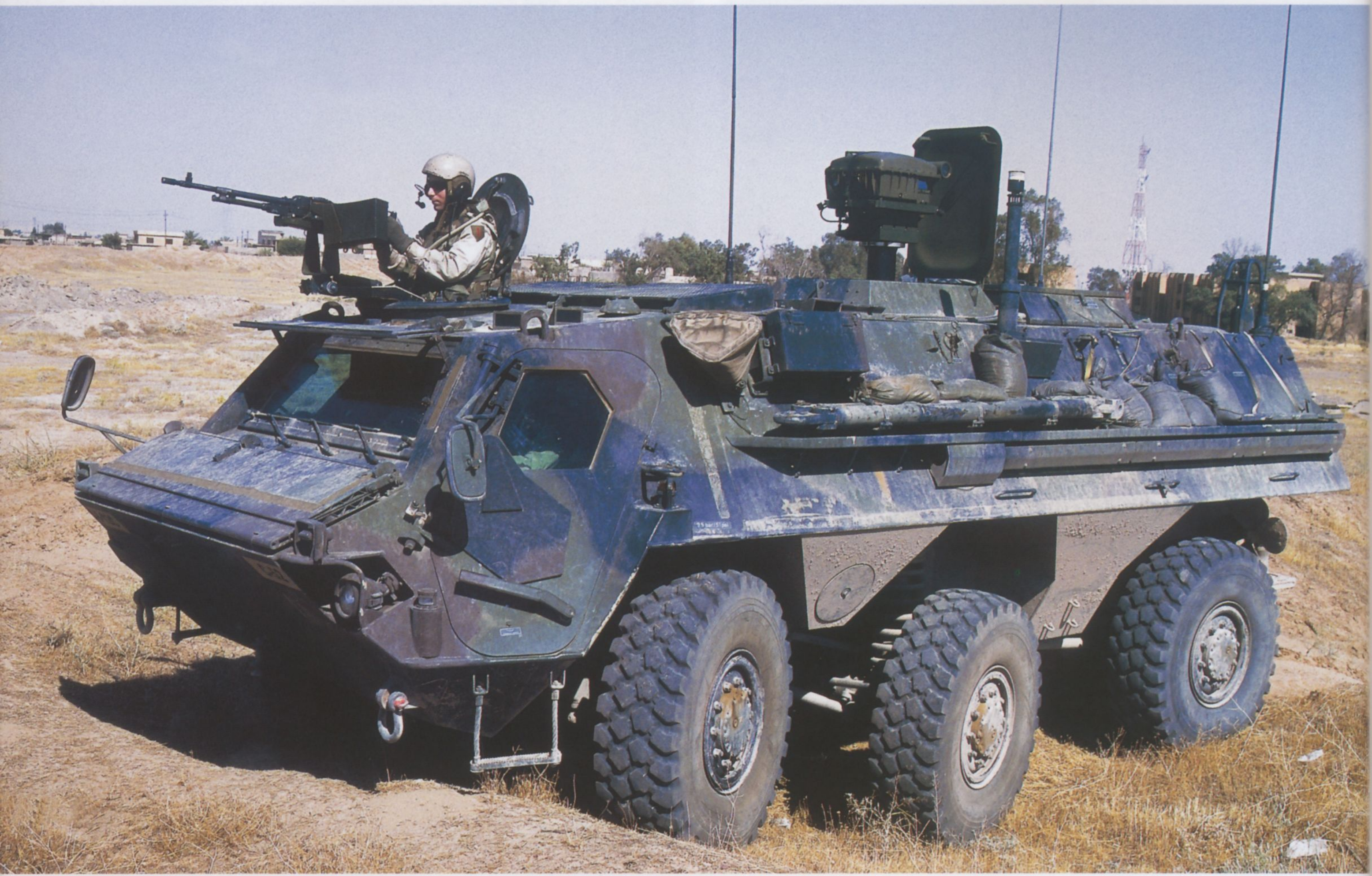
Basically the M93 Fox Nuclear, Biological, and Chemical (NBC) Reconnaissance System is a mobile laboratory that can detect and identify nuclear and chemical threats. The laboratory is mounted in a 6x6 wheeled, amphibious APC. Originally the vehicle was designed for the German Armed Forces in the 1960s and 1970s. Series production of the Fox, called Transportpanzer Fuchs in Germany, started in 1979. The Bundeswehr received some 1000 Transportpanzer Fuchs in different variants, including the standard APC, ambulance, command post, electronic warfare, and NBC reconnaissance system. In the late 1980s the U.S. Army identified an NBC reconnaissance capability gap in its vehicle inventory. In order to close this gap in as short a time as possible, it was decided to procure an off-the-shelf item rather than develop a new vehicle. Following this decision, several vehicles from different manufacturers were evaluated under a Foreign Technology Evaluation Program.

In 1988 five Transportpanzer Fuchs in the NBC Reconnaissance Vehicle version (designated Spürpanzer Fuchs TPz 1A6 by the Bundeswehr) were purchased for trials. The U.S. Army gave the vehicles the designation XM93 NBCRS. In 1990 Henschel Wehrtechnik (today Rheinmetall Landsysteme), which had teamed up with GDLS, received an order for 48 vehicles, these being delivered in 1992-93, and type classified M93 Fox NBCRS. Due to the 1991 Gulf War, the U.S. Army borrowed 60 vehicles from the German Army prior to the delivery of its own M93 vehicles. These were then fielded in the Gulf War and finally bought by the U.S. Army. After 1991, the M93 Fox NBCRS was also deployed with U.S. IFOR and SFOR contingents in Bosnia from 1996 onwards, and with the KFOR contingent in Kosovo from 1998 onwards.

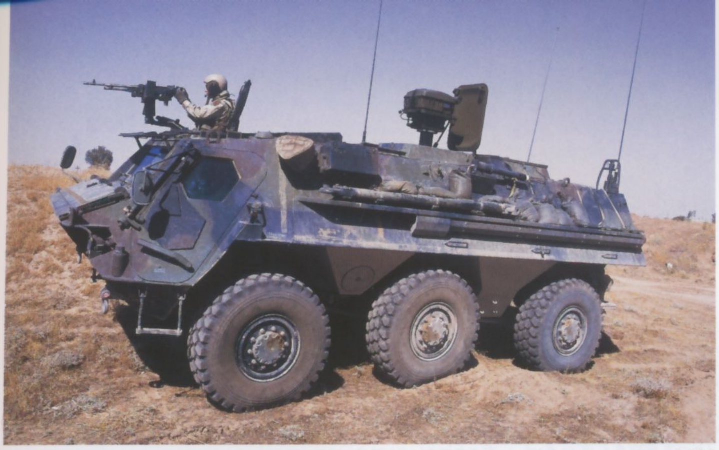
Under the System Improvement Phase, the army purchased ten additional modified prototypes designated M93E1 in 1990. Delivered in 1992-93, the vehicles went through intensive tests and were type classified as M93A1 in 1995. In the following years, 110 of the 113 Foxes purchased earlier were modified to M93A1 standard. The first unit to be issued the M93A1 Fox NBCRS was the Chemical Company of the 1st Cavalry Division at Ford Hood, Texas, in October 1998. The army also loaned ten M93A1s to the USMC. The mission of the M93A1 Fox NBCRS is to detect and mark areas of nuclear and chemical contamination, as well as to identify the type of contamination and agent used. Furthermore, the vehicle can take samples of soil, water and vegetation. The vehicle's communication equipment allows the crew to report reconnaissance results in real time.

Technical changes – M93 to M93A1

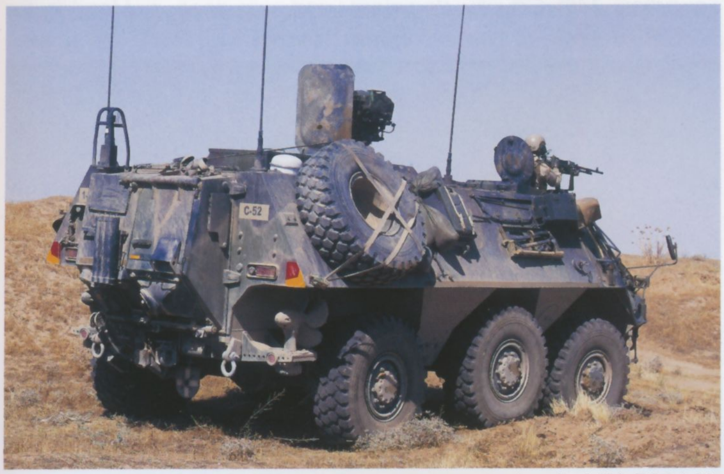
The M93A1 differs in several ways from the M93. The number of crewmembers was reduced from four to three, and old radio systems were replaced by SINCGARS ASIP radios that allow transmission of digital data. The vehicles were fitted with the AN/PSN-11PLGR and Autonomous Navigation System, as well as with control terminals for systems at the driver's and commander's stations. Also new is a meteorological station with sensor suite that measures wind speed, wind direction, air and ground temperature, and relative humidity. While the M21 Remote Sensing Chemical Agent Alarm (RSCAAL) was carried inside the M93 and could only be operated in a dismounted mode, this was changed on the M93A1 when the M21 RSCAAL was mounted on the roof. The new mount features a mast that can be elevated, allowing the M21 to be rotated 180° and adjusted in level on three axes. The M21 RSCAAL allows the M93A1 to



The M93A1 Fox NBCRS is basically a rolling laboratory designed to detect and identify nuclear and chemical contamination threats. During the invasion of Iraq, vehicles and crews were kept busy searching for the anticipated Iraqi arsenal of WMD. Later they were employed regularly to check sites where bombing and IED attacks took place. The pictured M93A1 NBCRS belongs to the 12th Chemical Company and was seen near Baiji in June 2004. Note that the M21 RSCAAL has been raised.



Another picture of the same M93A1 Fox NBCRS. In evidence is the M21 RSCAAL and folded-down sensor of the meteorological station. The M93A1 has a combat weight of 18,300kg and a crew of three soldiers. The vehicle is powered by a Daimler Benz OM 402A V8 diesel engine developing 320hp, which offers a top speed of 105km/h.



Here an M93A1 Fox NBCRS can be seen employing its M21 RSCAAL. The vehicle belongs to the 12th Chemical Company of the 1st Infantry Division. With the M21 RSCAAL, clouds of chemical agents can be identified out to a distance of 3-5km. Note the rear of the vehicle where most of the sample-collecting equipment is mounted.

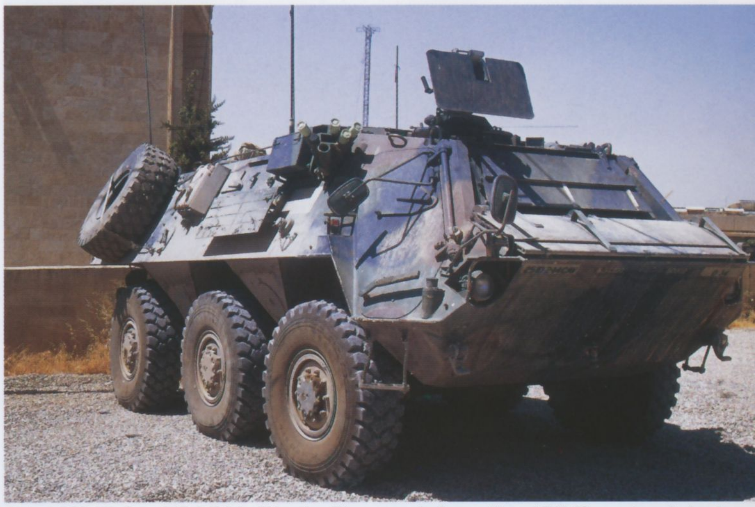
detect chemical agent clouds at a distance of 3-5km. A video camera is mounted coaxially with the M21 RSCAAL, while detection results and video footage captured by the roof-mounted sensors can be displayed on the commander's display and on a new monitor at the workstation in the rear of the vehicle. Systems can be controlled from both terminals, plus they show information supplied by the MM1 Mobile Mass Spectrometer. All sensors, including vehicle navigation and communication systems, are linked together via a Multipurpose Integrated Chemical Agent Detector/Alarm. Therefore, the MICAD/A (which has a keyboard and printer) allows the crew to warn friendly forces of contamination in the shortest possible time.

Reconnaissance platoons of chemical companies in army heavy divisions can field a total of six M93A1 Fox NBCRS vehicles. A similar number are available in the chemical company of an armored cavalry regiment. Initially, some Stryker Brigade Combat Teams (SBCT) were also equipped with three M93A1 NBCRS. However, these vehicles have since been replaced by the M1135 Stryker NBCRS. Currently the U.S. Army plans to modify its M93A1 fleet to A2 standard by adding a mass spectrometer that can also identify biological threats. There are also plans afoot to purchase an additional 21 vehicles from German Army stocks and to upgrade them to M93A1 standard.

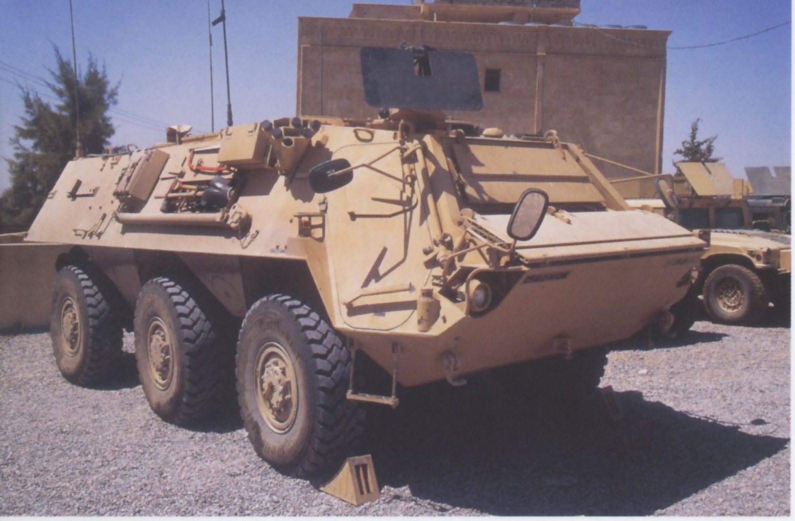
Weapons of Mass Destruction and chlorine

During OIF, the bulk of Foxes deployed were the newer M93A1. However, older M93 vehicles also saw service during the invasion of Iraq. Vehicles were used intensively during initial fighting out of fear that Saddam Hussein might use chemical weapons to stop the Coalition's advance. Although the Iraqi Armed Forces never used Weapons of Mass Destruction (WMD), M93 and M93A1 Fox NBCRS vehicles with their crews were kept busy even after the conflict. At that time they were involved in the hunt for hidden WMD storage sites. When the insurgency kicked off, the lack of suitable wheeled, armored vehicles in the army inventory led to the employment of M93A1s as convoy escorts. In early 2007 insurgents began conducting attacks with crude chemical weapons, basically suicide VBIEDs containing explosives and barrels of chlorine. After exploding, an SVBIED prepared with chlorine generates a cloud of toxic fumes. As a response to the employment of chlorine IEDs, M93A1 Fox NBCRS vehicles saw action on several occasions in order to check out IED incident sites for any possible contamination. The searches that were conducted did not only test for chlorine, as there was a risk insurgents might also employ other toxic chemicals as weapons.

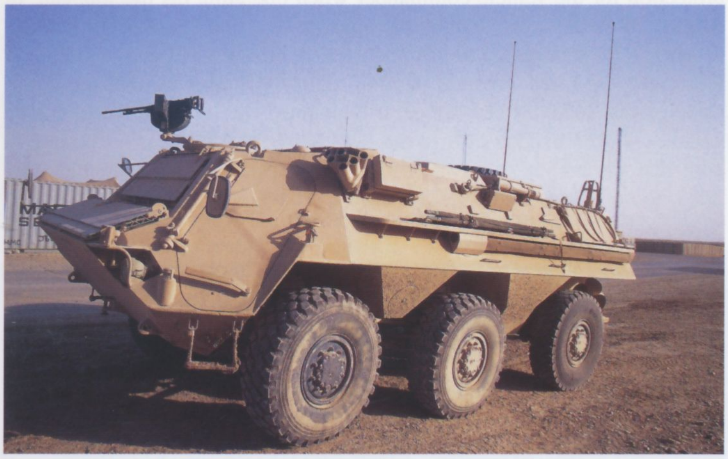
The M93A1 Fox NBCRS was also regularly employed to check out IED factories discovered by Coalition forces to determine whether toxic chemicals were used in the manufacturing process. Operational modifications made to M93s and M93A1s in OIF were only minor. Some vehicles were seen fitted with gunner shields in order to give additional protection for the vehicle commander when operating his machinegun. In August 2007, the army ordered the upgrade of a first batch of 24 vehicles to M93A1P1 standard. The M93A1P1 Fox NBCRS features a Common Remotely Operated Weapon Station (CROWS) and an add-on armor package that includes slat armor. It is planned the last of these upgraded vehicles will be handed over to the U.S. Army in 2009. It is interesting to note that the author saw two M93A1s featuring slat armor in February 2007, these belonging to the 3rd SBCT, 2nd Infantry Division, at Camp Victory in Baghdad.



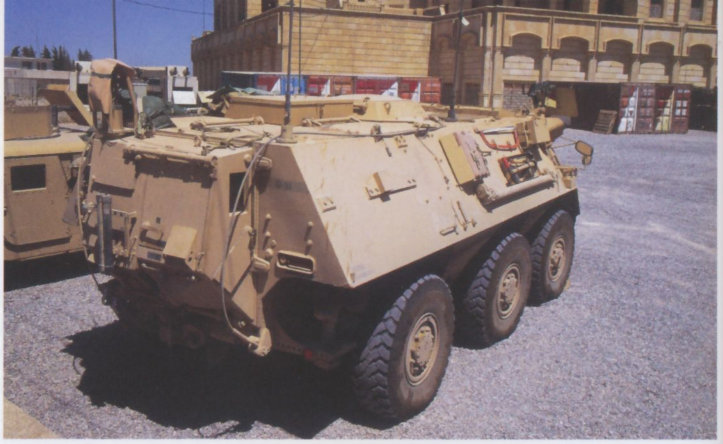
This M93A1 Fox NBCRS is fitted with panels from the JCIMS and painted in a NATO three-color camouflage pattern. It belongs to the 1st SBCT, 25th Infantry Division. In its inventory an SBCT has three M93A1 Fox NBCRS. At the time of writing, the Foxes in SBCTs will be replaced by the M1135 Stryker NBCRS. The pictured vehicle is fitted with a gunner shield and was seen in Mosul in August 2005.



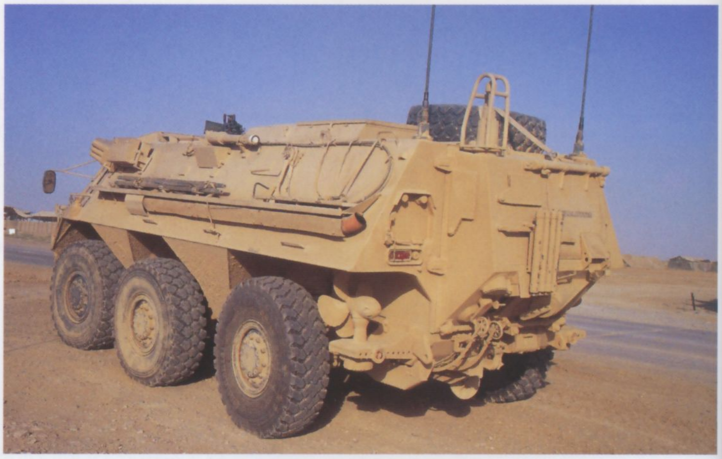
This picture shows another M93A1 Fox NBCRS also seen in Mosul in August 2005. The vehicle belongs to the NBC Reconnaissance Platoon, Surveillance Troop, of the 2nd Squadron, 14th Cavalry Regiment. The squadron belongs to the 1st SBCT, 25th Infantry Division. Like the vehicle in the previous picture, it is fitted with a gunner shield.



This M93A1 Fox NBCRS belongs to the 89th Chemical Company of the 3rd Armored Reconnaissance Regiment. It was seen in the American camp at the former Iraqi Tall Afar Air Force Base. The 89th Chemical Company can field a total of six M93A1 Fox NBCRS. Note that the armored shutter protecting the windscreen of the vehicle has been closed.



The M93A1 is a 6x6, wheeled, armor-protected laboratory designed to identify nuclear and chemical threats on the battlefield. The comprehensive detection and analysis equipment is mounted in the rear of the vehicle. It includes an M21 RSCAAL, MM1 Mobile Mass Spectrometer, Improved Chemical Agent Monitor, AN/VDR-2 Beta Radiac, and M22 ACADA. The pictured vehicle belongs to the 2nd Squadron, 14th Cavalry Regiment, and was seen in Mosul in the summer of 2005.



This rear view of the same M93A1 Fox NBCRS clearly illustrates the sample-collecting equipment. It includes two silicon sampling wheels that can be lifted against the MM1 probe head, a sampling gripper assembly stored in a drawer, four tubes in which plastic containers for holding samples are stored, and a circular hatch through which an operator using a special sealed protective glove can collect samples.

Technical Data for M93A1 Fox NBCRS

Combat weight:	18,300kg
Crew:	3 (driver, commander and system operator)
Length:	7.29m
Width:	2.98m
Height:	2.40m
Engine:	Daimler Benz OM 402A V8 diesel engine developing 320hp
Transmission:	ZF 6HP 500 automatic transmission with six forward and one reverse gears
Maximum speed:	105km/h
Fording:	amphibious, swimming speed of 10km/h
Fuel tank capacity:	390 liters
Road range:	797km
Gradient:	60%
Side slope:	30%
Ground clearance:	381mm
Vertical obstacle:	609mm
Trench crossing:	1.067m
Turning radius:	8.5m
Armament:	1x 7.62mm M240 MG, 2x M250 Smoke Grenade Launchers (each with six tubes)
Ammunition:	2800 rounds 7.62mm ammunition
Systems:	M21 Remote Sensing Chemical Agent Alarm (RSCAAL), MM1 Mobile Mass Spectrometer, Chemical Agent Monitor/Improved Chemical Agent Monitor (CAM/ICAM), AN/VDR-2 Beta Radiac, and M22 Automatic Chemical Agent Detector/Alarm (ACADA), SINCGARS ASIP radios, Fox commander's display, AN/PSN-11PLGR and Autonomous Navigation System (ANAV) and MICAD/A
Manufacturer:	Henschel Wehrtechnik teamed with GDLS

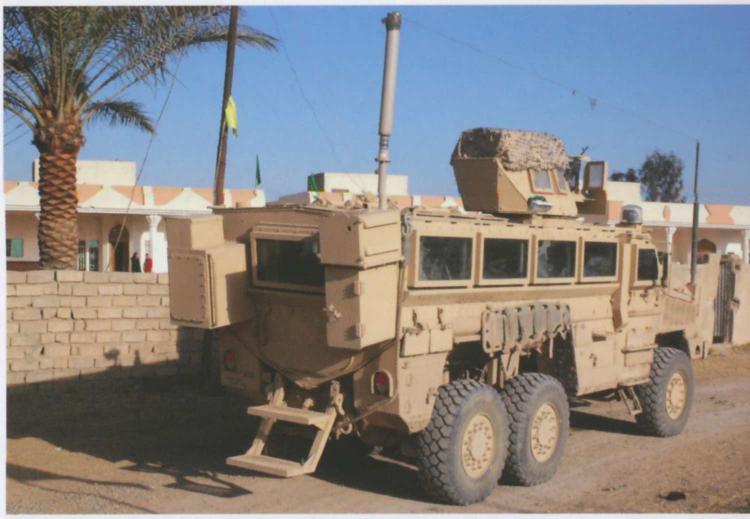
RG-33L 6x6 Mine Resistant Ambush Protected Vehicle

Under the Mine Resistant Ambush Protected (MRAP) vehicle program, the U.S. Army and USMC recently began procuring vast numbers of new vehicles. Due to their size and mission, vehicles are classed into three categories. Category II includes medium-sized vehicles for a wide range of roles including troop transport, ambulance, EOD team vehicle, and convoy escort vehicle. One of the vehicles procured under Category II is the RG-33L manufactured by BAE Systems. The RG-33L was developed by subsidiary BAE Systems Land Systems South Africa, a company formerly known as Land Systems OMC. A first order for 75 RG-33L vehicles was placed by the U.S. Armed Forces in January 2007. This was followed by additional orders for 255 vehicles in June 2007, 511 in October 2007 and 600 in December 2007. Since fielding of the RG-33L started in 2007, vehicles have been issued to units of the army, USMC and Special Operations Command. Among RG-33L variants ordered and fielded so far are different versions of the infantry carrier, some featuring firing ports in the ballistic-glass windows, as well as an ambulance variant. The RG-33L Ambulance accommodates several litter patients as well as ambulatory ones. It also features a medical workstation and an array of medical equipment. It is believed the army has also procured C? variants. In Category I of the MRAP program, U.S. Armed forces have also procured large numbers of RG-33 4x4 vehicles, the smaller brother of the RG-33L. Both vehicles share a large number of common parts.

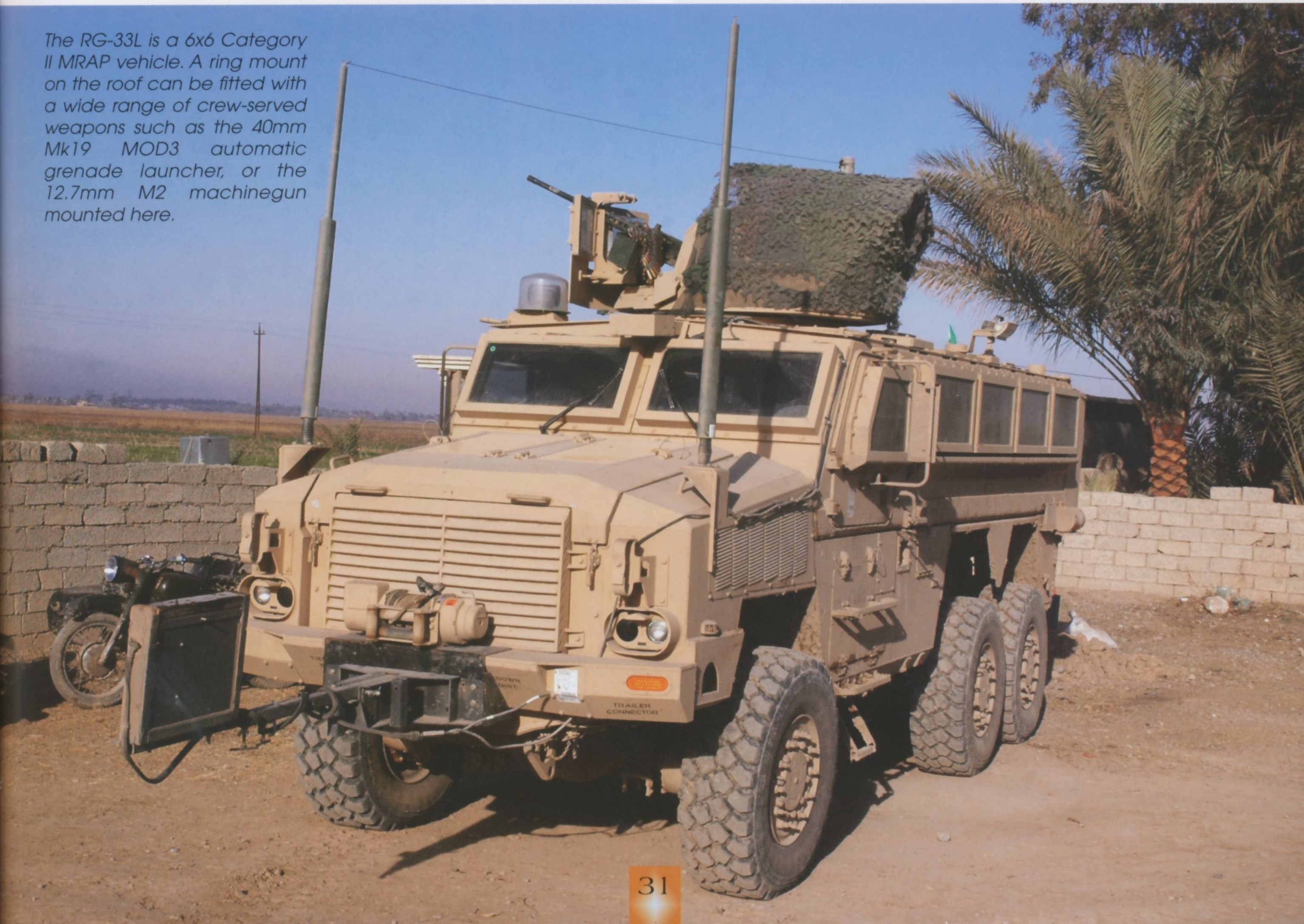
High degree of protection

The RG-33L is a 6x6 armor-protected vehicle specially designed to survive mine blasts and IED attacks. It also offers 360° protection against small-arms fire up to a caliber of 7.62mm. The vehicle features a V-shaped monocoque armored hull. Vehicle armor is of the composite type and includes steel, ceramic and Kevlar. Windows are made of ballistic-resistant glass that can survive multiple hits. Layout resembles that of a standard truck with the armor-protected engine compartment situated at the front, the transmission centrally located beneath the two front seats of the driver and vehicle commander, and a crew compartment situated at the rear.

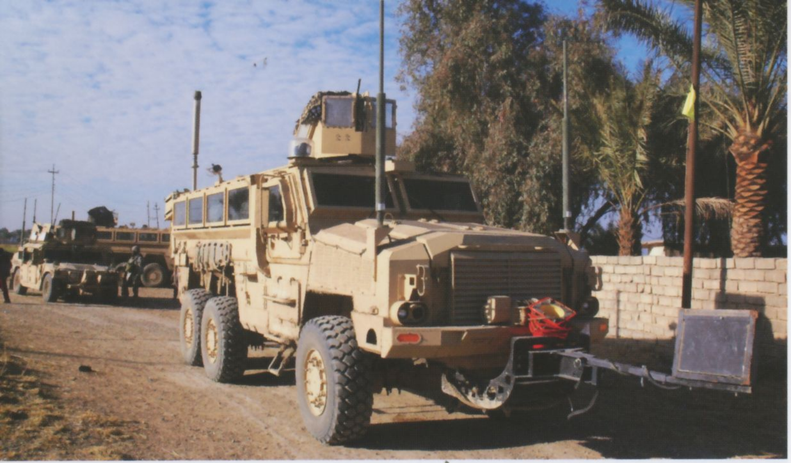
The driver and commander enter the vehicle through two doors on the left and right sides behind and above the front axle. Inside the hull there is



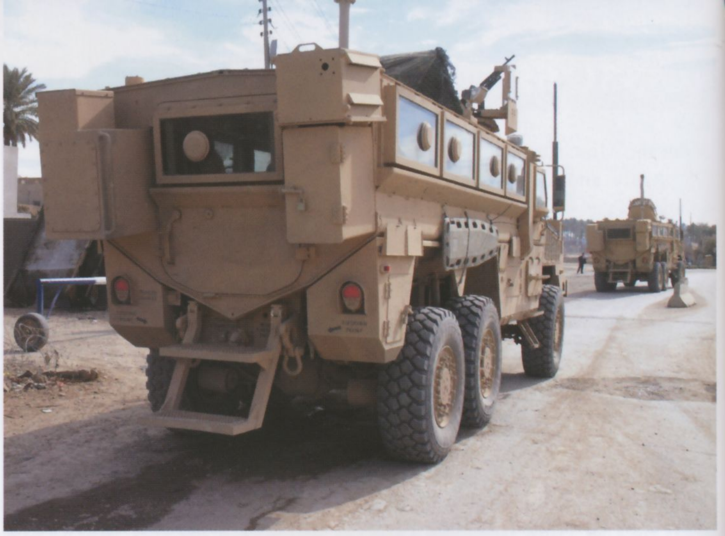
This rear view of an RG-33L MRAP clearly shows the V-shaped monocoque hull. Crew protection was paramount when the vehicle was designed and this shape provides maximum blast protection, while the thick armor protects the crew from small-arms fire and splinters. The fact that the fuel tanks are situated at the rear outside the hull also benefits crew protection.



The RG-33L is a 6x6 Category II MRAP vehicle. A ring mount on the roof can be fitted with a wide range of crew-served weapons such as the 40mm Mk19 MOD3 automatic grenade launcher, or the 12.7mm M2 machinegun mounted here.



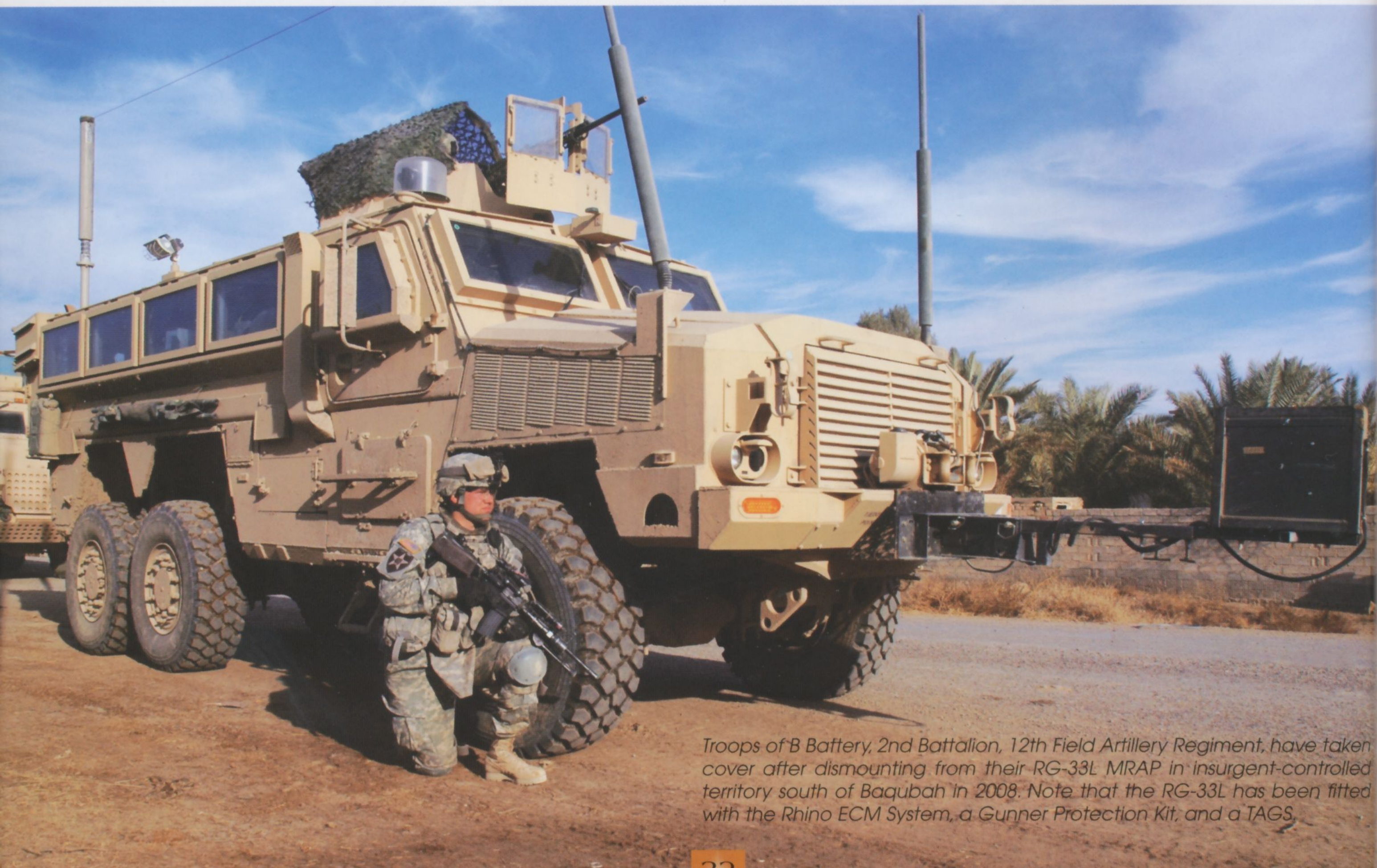
A patrol of B Battery, 2nd Battalion, 12th Field Artillery Regiment, has stopped in a small village south of Baqubah. In addition to two RG-33L MRAPs, the patrol also consists of an M1151A1 HMMWV Expanded Capacity Armament Carrier/Integrated Armor Package/Armor Ready. The ring mount on the roof of the RG-33L has been fitted with a 7.62mm M240B machinegun.



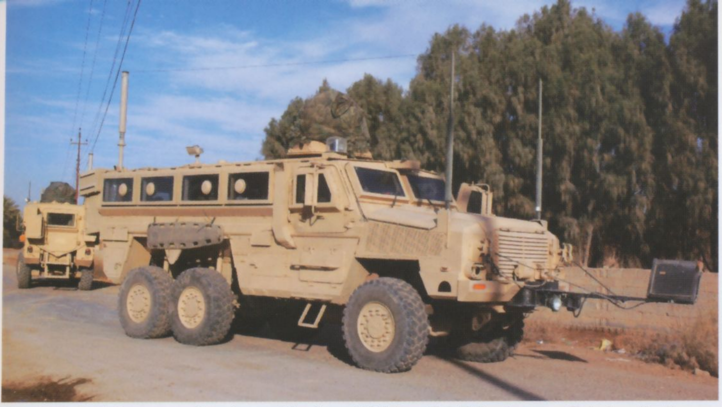
Another rear view of an RG-33L MRAP belonging to B Battery, 2nd Battalion, 12th Field Artillery Regiment. It was seen in Baqubah in early 2008. Note the firing ports situated in the side and rear windows.

space for up to ten troops, including the driver and commander. When the roof-mounted machinegun ring is manned, it is also possible to carry an additional soldier. The troop compartment is accessed through a large one-piece rear door that weighs some 400kg and features a bulletproof window. Along the left and right sides of the crew compartment are four large windows that provide a degree of vision for troops traveling in the back. In some variants of the RG-33L, these windows feature firing ports that allow troops to engage targets with their small arms. The seats for the driver and vehicle commander, as well as the eight seats in the rear grouped into two groups of four, are blast protected. They are made by Armor Works and feature an energy-attenuating system. The eight troop seats feature four-point seatbelts while the two front seats have five-point belts. The seats protect troops riding in the RG-33L from the destructive shock of a blast beneath the vehicle.

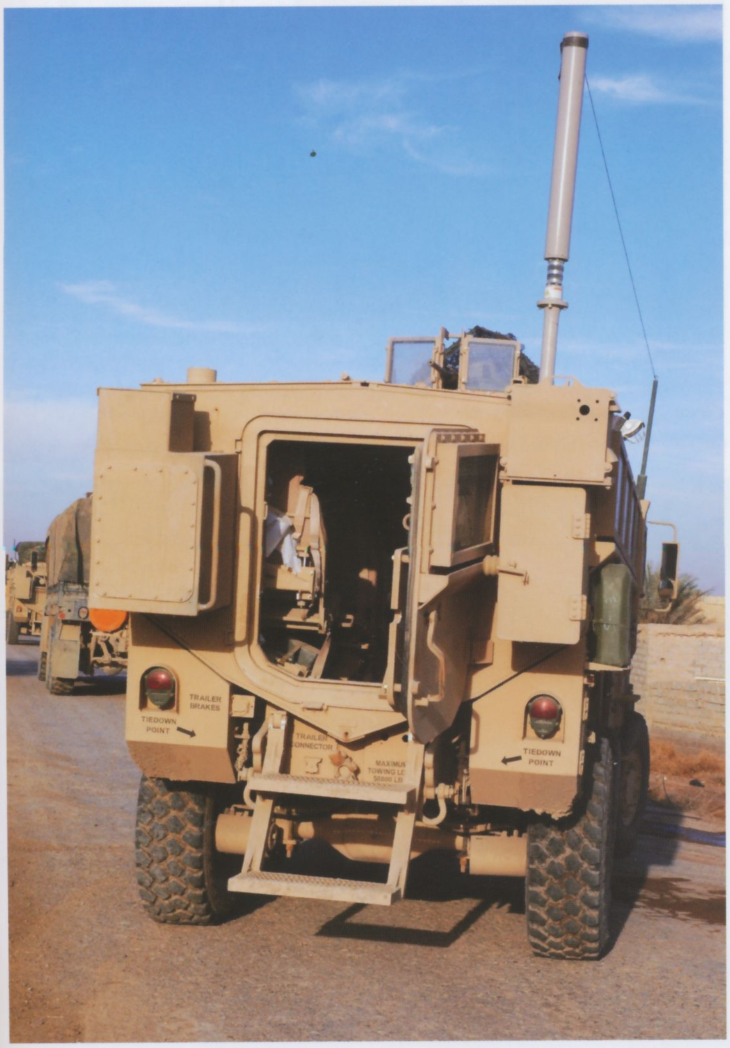
A large circular hatch is located in the roof of the RG-33L, just behind the two front seats. This hatch gives access to the roof ring mount that can be fitted with a wide range of crew-served weapons such as a 7.62mm M240B machinegun, 12.7mm M2 machinegun or 40mm Mk19 MOD3 automatic grenade launcher. To the rear are four additional roof hatches, two each on the left and right sides. In addition to the crew compartment, other vital parts of the vehicle are also protected by armor. This includes the engine compartment, transmission and fuel tanks, the latter situated at the rear outside the vehicle. A small fuel tank with enough fuel to travel a distance of 50km in case of emergency, or when the other fuel tanks are destroyed, is situated inside the engine compartment. The RG-33L features air brakes and power-assisted steering. The RG-33L offers a good cross-country capability, though driving off-road is not a pleasure for the crew because the suspension tends to bounce up and down a lot.

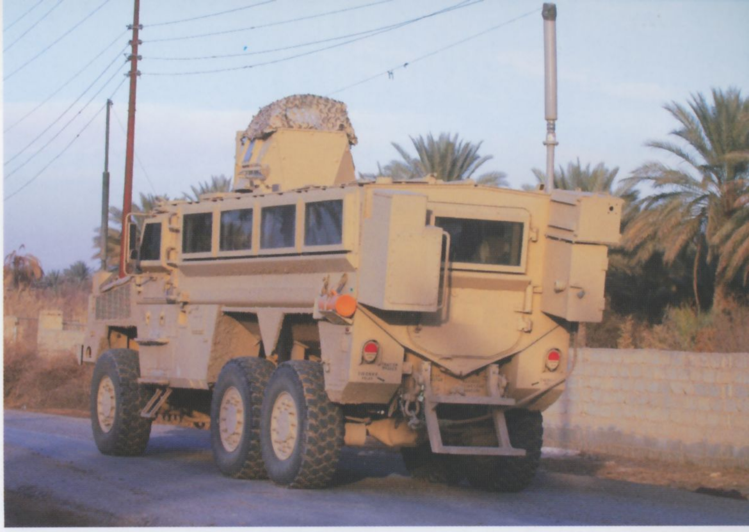


Troops of B Battery, 2nd Battalion, 12th Field Artillery Regiment, have taken cover after dismounting from their RG-33L MRAP in insurgent-controlled territory south of Baqubah in 2008. Note that the RG-33L has been fitted with the Rhino ECM System, a Gunner Protection Kit, and a TAGS.

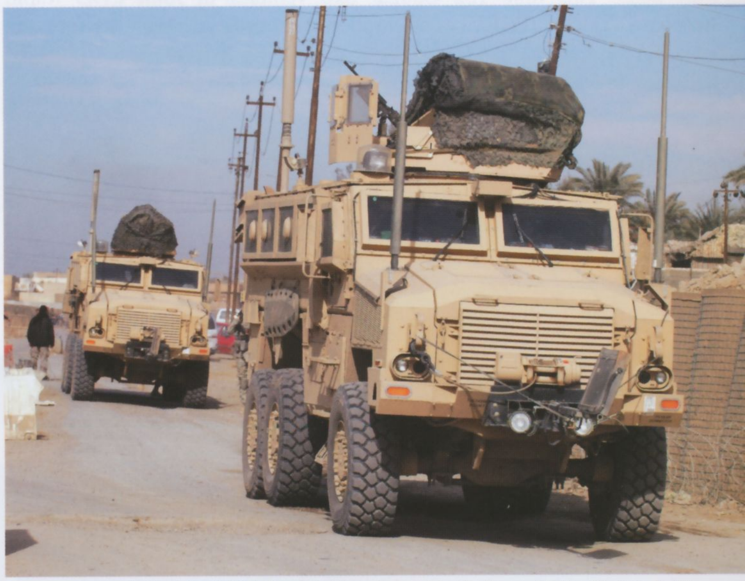


The RG-33L is manufactured in the USA by BAE Systems. Originally it was designed by the South African subsidiary formerly known as Land Systems OMC. Here the RG-33L can be seen in an infantry carrier version. Note the firing ports in the side windows that allow troops in the well-protected rear compartment to use small arms to return fire when under attack.





Rear view of another RG-33L MRAP. The vehicle is one of 18 given to the 2nd Battalion, 12th Field Artillery Regiment, in late 2007. It does not feature firing ports in the side and rear windows. Note the antenna of the ECM system mounted on the roof to the right rear.



These two RG-33L MRAPs of the 2nd Battalion, 12th Field Artillery Regiment, were seen patrolling the southern outskirts of Baqubah in January 2008. Both are infantry carriers and feature a machinegun ring mount. To protect the gunner they have been fitted with Gunner Protection Kits and Gunner Shield Kits. Note that both vehicles are fitted with a selection of ECM equipment in order to counter the IED threat, including the Rhino and Duke ECM.

Rear view of an RG-33L MRAP, with the armored rear door visible. The manually operated door has a weight of some 400kg. The composite armor consists of steel, ceramic and Kevlar.

Technical Data for RG-33L MRAP Category II

Crew:	1 + 10 (driver, vehicle commander, gunner and up to eight dismounts)
Length:	8.458m
Width:	2.515m
Height:	2.845m
Curb weight:	22,000kg
Gross vehicle weight:	27,600kg
Engine:	turbocharged diesel engine developing 450hp
Transmission:	five-speed automatic transmission
Top speed:	107km/h
Manufacturer:	BAE Systems

Cougar 4x4 and 6x6 MRAP vehicles

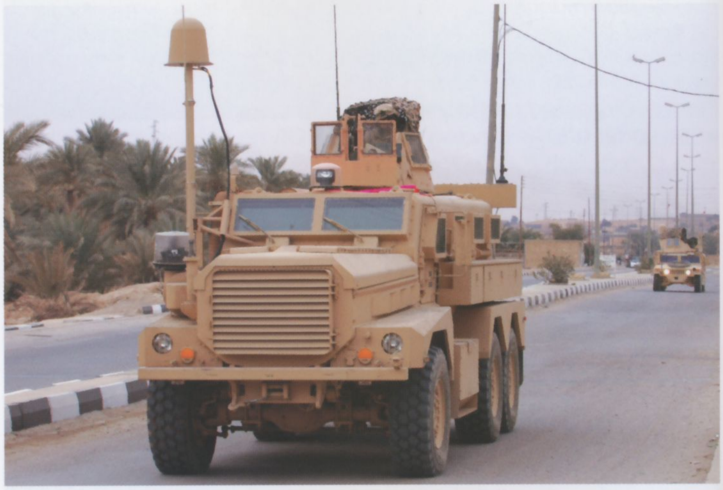
The Cougar family of wheeled vehicles consists of a 4x4 Category I MRAP and a 6x6 Category II MRAP. The Cougar Light Armored Vehicle also belongs to this family. The vehicles are designed and manufactured by Force Protection Incorporated. In 1997 the company was formed with the sole aim of developing wheeled vehicles offering a high degree of protection for their crews. Force Protection Incorporated began design work on the Cougar family of vehicles in the late 1990s and it has been marketing them since March 2004.

Around the same time the USMC conducted a market survey of armored and mine-protected vehicles, during which it came across the new Cougar family. In April 2004 the USMC ordered a first batch of 30 Cougars in 4x4 configuration that were shipped directly to Iraq after leaving the production plant of Force Protection Incorporated. They were designated Cougar Hardened Engineer Vehicles and subsequently entered service with EOD teams of the 31st Marine Expeditionary Unit Service Support Group. In the following months the Cougars proved themselves in the field, withstanding IED explosions and turning out to be very reliable technically. As a result of their outstanding performance, the USMC ordered additional Cougars in May 2005. This time 122 Cougar 6x6 vehicles in Joint EOD Rapid Response Vehicle (JERRV) configuration were ordered. After delivery, the vehicles were fielded in USMC and army units to provide EOD teams operating in Iraq and Afghanistan with adequately protected transport.

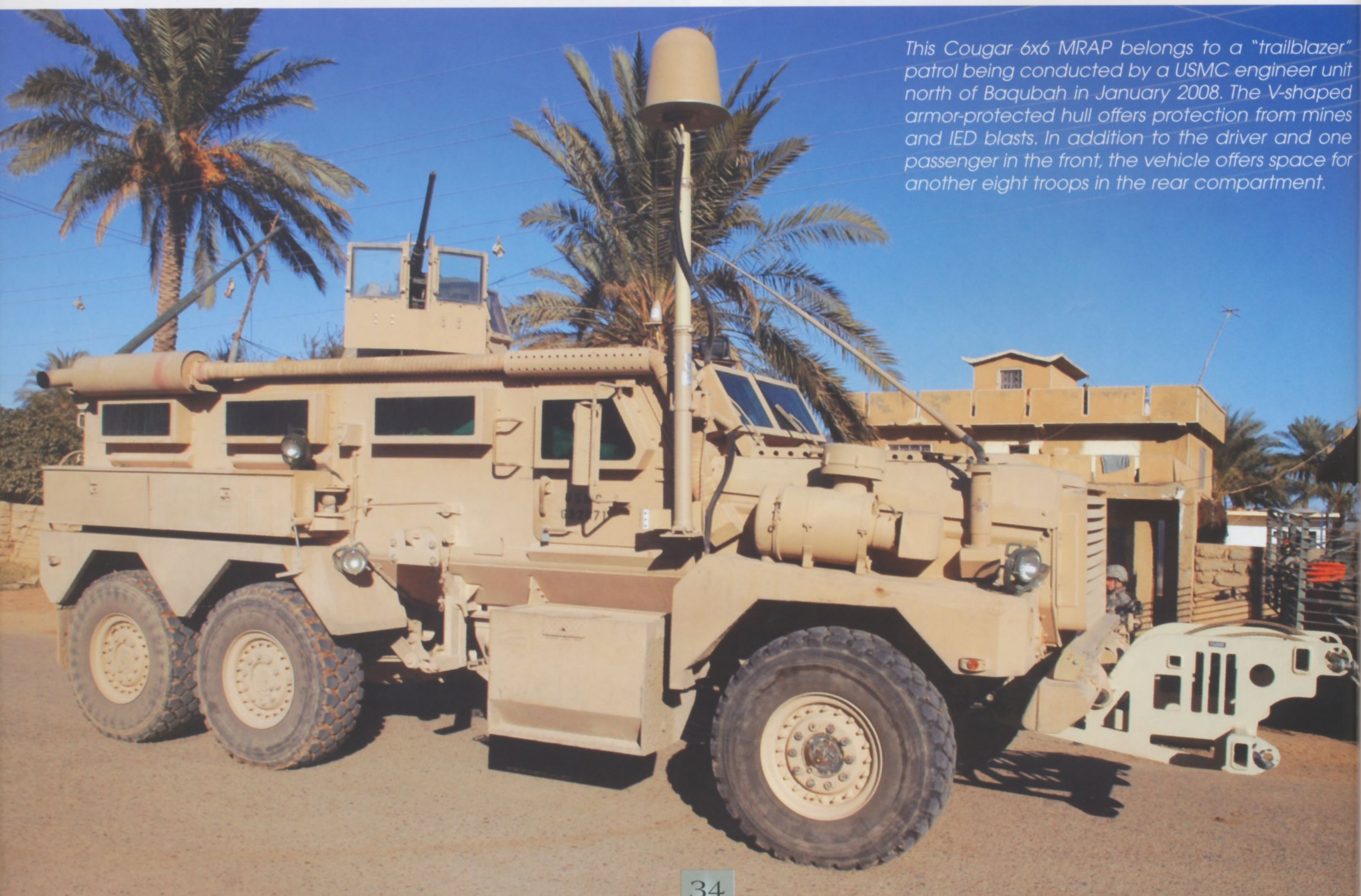
With the launch of the MRAP program, several additional Cougar 4x4 and 6x6 vehicles were ordered. By November 2007 the U.S. Armed Forces had received a mix of 978 Cougar 4x4 and 6x6 vehicles with more than 1000 additional vehicles on order. Furthermore, Force Protection Incorporated also delivered 153 Cougar Light Armored Vehicle to the Iraqi Armed Forces. It also manufactures large numbers of Buffalo Mine Protected Clearance Vehicles for the U.S. Armed Forces. The Cougar 4x4 Category I MRAP and Cougar 6x6 JERRV Category II MRAP are used by U.S. forces as transport for EOD teams and their equipment, lead vehicles in convoys, transport for first-response units, mine-protected field ambulances, and patrol vehicles.

V-shaped hull and ballistic glass

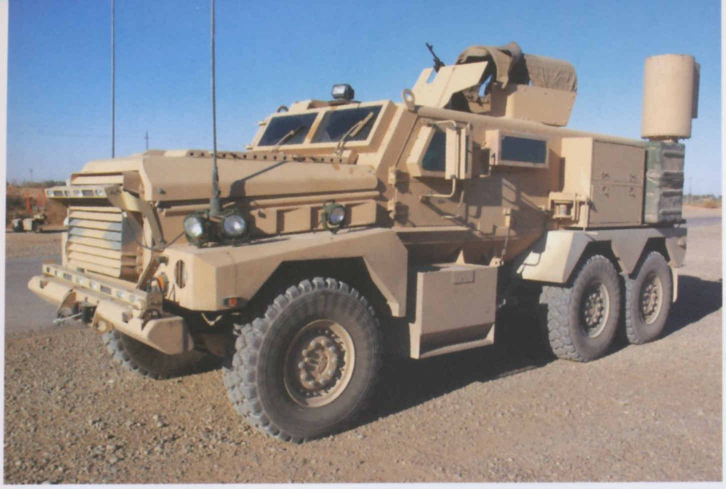
The Cougar 4x4 and 6x6 both feature a V-shaped armored hull offering a high degree of blast protection from IED and mine explosions. Cougars can withstand an antitank mine or IED detonation under one of their wheels or



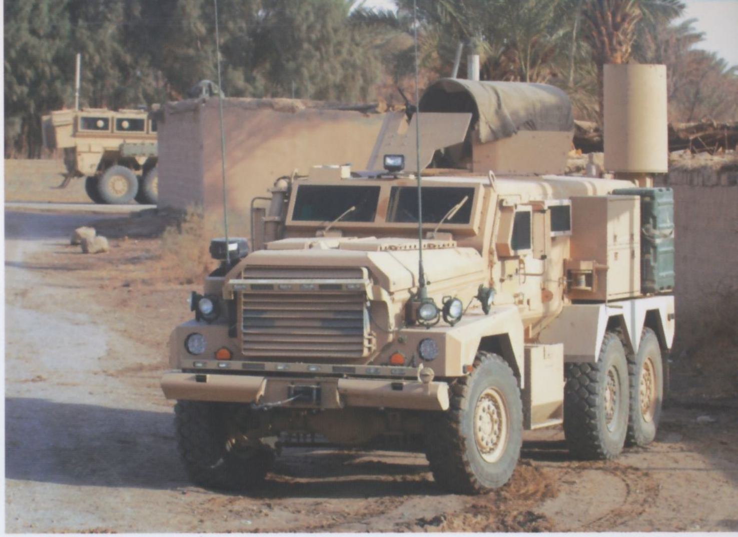
A Cougar 6x6 MRAP Category II of a USMC unit thunders down a road in Hadithah in January 2007. The Cougar 6x6 is powered by a Caterpillar C-7 diesel engine developing 330hp at 1450rpm. Connected to an Allison 3500 SP automatic transmission, the engine allows the 17,550kg vehicle to reach a top speed of 105km/h.



This Cougar 6x6 MRAP belongs to a "trailblazer" patrol being conducted by a USMC engineer unit north of Baqubah in January 2008. The V-shaped armor-protected hull offers protection from mines and IED blasts. In addition to the driver and one passenger in the front, the vehicle offers space for another eight troops in the rear compartment.



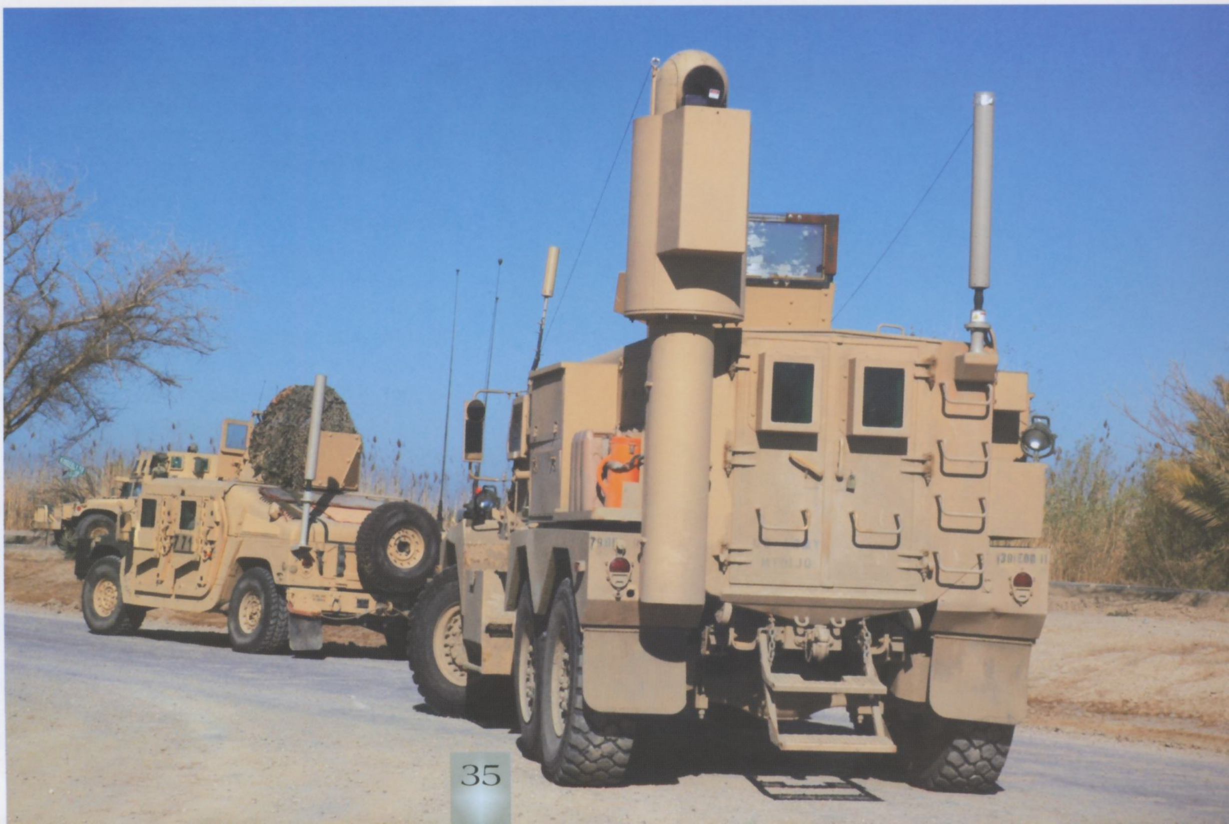
This Cougar 6x6 JERRV of an army EOD team was seen in Baqubah in January 2007. The vehicle features a Gunner Shield Kit, Gunner Protection Kit, and Gyrocam System Triple-Sensor-Camera system. Note the thick windows made from ballistic glass.



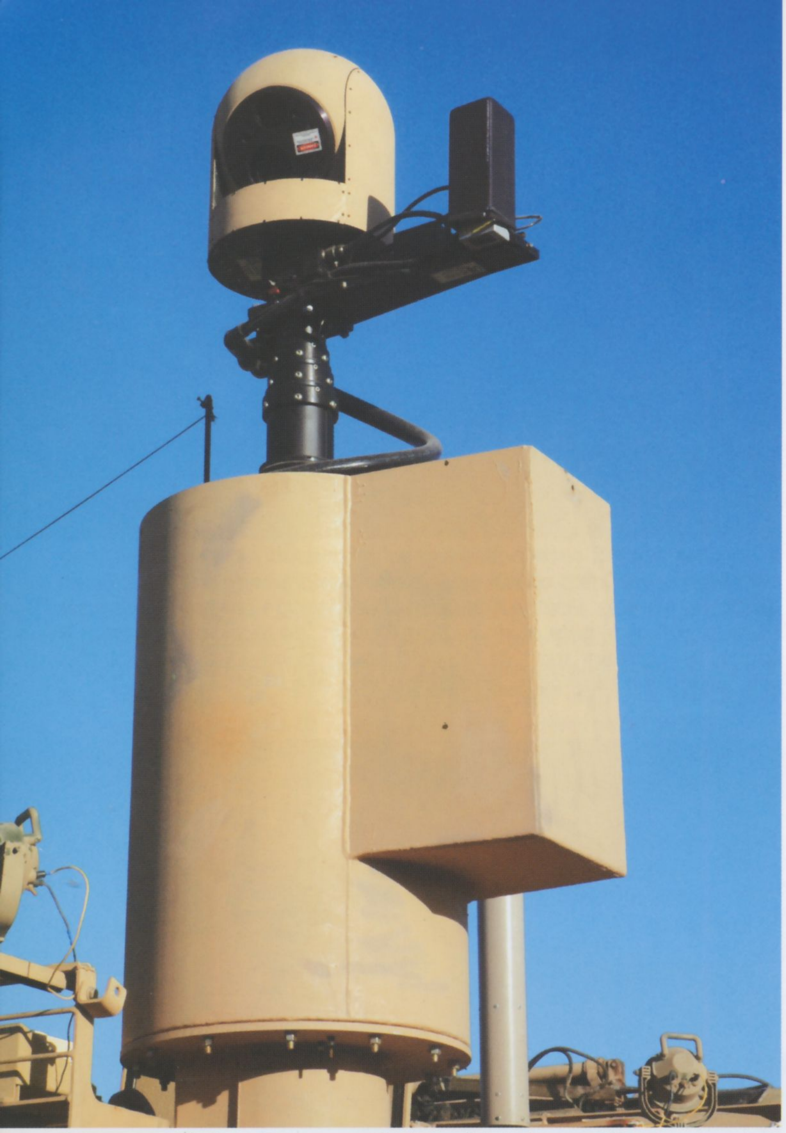
In Iraq the Cougar 6x6 is employed as a transport vehicle for U.S. Army and Marine EOD teams, hence it is also designated Joint EOD Rapid Response Vehicle. Here a Cougar 6x6 JERRV can be seen during an operation somewhere south of Baqubah. In the rear compartment is special equipment such as an EOD robot, bomb-disposal suits, tool sets, explosives, blast caps and detonation cord.

under the centerline of the vehicle's body. The armor and ballistic glass of the Cougar protects the crew from small-arms fire of weapons up to 7.62mm in caliber. The ballistic glass can withstand multiple hits. Inside the crew compartment, passengers are seated in blast-protected seats that feature shock-absorbing technology and four-point seatbelts. In addition to the crew compartment, several vital automotive parts of the Cougar are also protected, including the engine, transmission and fuel tank. Layouts of the 4x4 and 6x6 Cougar are identical, with the engine compartment at the front above the front axle. The driver and vehicle commander are seated behind the engine compartment, and they reach their seats through side doors in the left and right sides of the hull. At the rear is the crew compartment, reached through a large one-piece rear door.

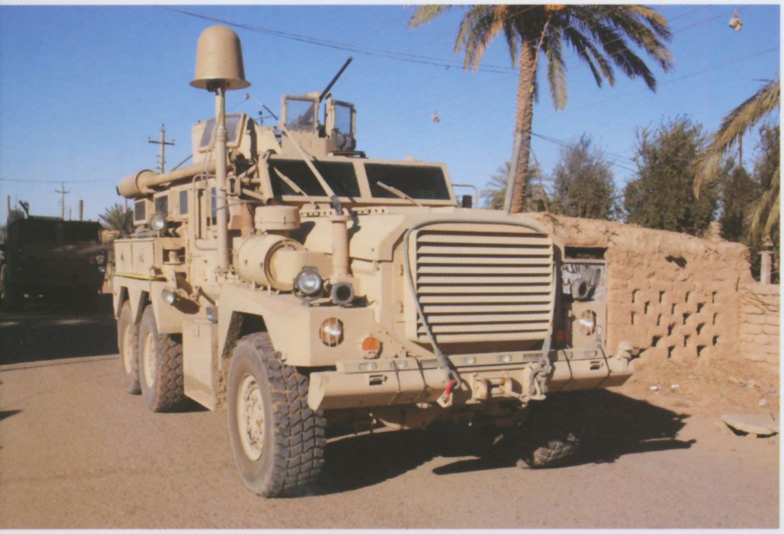
Cougars are powered by a Caterpillar C-7 diesel engine developing 330hp at 1450rpm. The engine is coupled to an Allison 3500 SP automatic transmission that allows it to reach a top speed of 105km/h. With a single tank, Cougars have a road range of 676km. The wheels feature Hutchinson Variable Function Inserts (VFI) mounted in their tires. The VFI provides Cougars with a run-flat capability allowing them to continue missions for a limited time even if the tires have been punctured. The suspension system permits driving both on and off the road. Vehicles have a ground clearance of 380mm under their transfer case. Water obstacles up to 990mm deep can



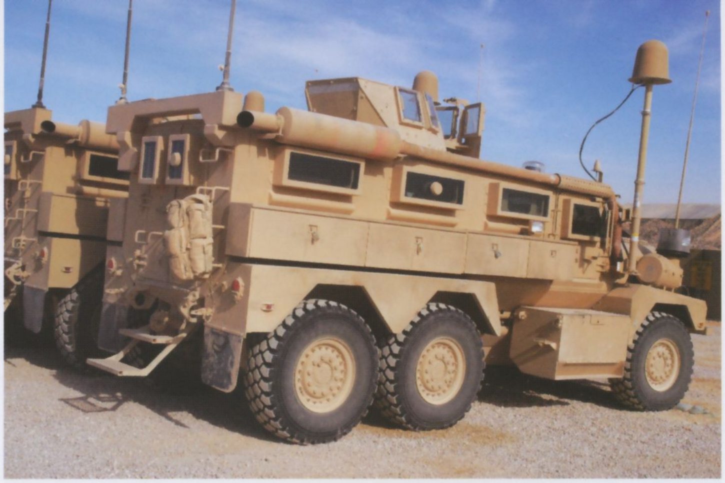
Rear view of a Cougar 6x6 MRAP fitted with a Gyrocam System Triple-Sensor-Camera system. This camera system is employed to search for IEDs, and allows operators to conduct surveillance in bright light, low light or darkness, even when the vehicle is moving. This one belongs to a "trailblazer" patrol of the 9th Engineer Battalion in Baghdad in March 2007.



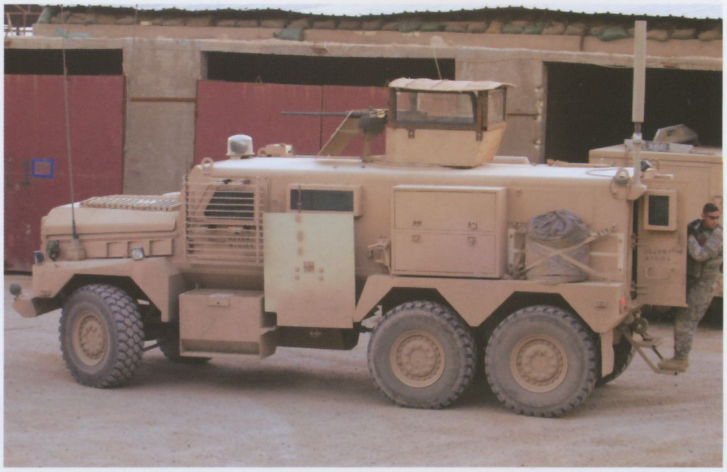
Close-up of the Gyrocam System Triple-Sensor-Camera system consisting of a high-resolution color camera, infrared thermal imager, and night-vision low-light camera. It is mounted on a pneumatic telescoping mast. Because the system is gyrostabilized, movements and vibrations inherent with images captured by a camera on a moving platform are eliminated, rendering clear and stable images on the control-panel screen inside the vehicle.



In November 2007, the U.S. Armed Forces had fielded a total of 978 Cougar 4x4 and 6x6 MRAP vehicles. Here a Cougar 6x6 Category II MRAP can be seen taking part in a road-clearance mission somewhere north of Baqubah in January 2008. The vehicle has been fitted with a Gunner Shield Kit, Gunner Protection Kit and Chameleon ECM system.



Rear view of a Cougar 6x6 Category II MRAP. The pictured vehicle belongs to the 3rd Light Armored Reconnaissance (LAR) Battalion of the USMC, and in December 2007 it was being operated in addition to their LAV-25s. While the JERRV version of the Cougar 6x6 does not feature side windows, this Cougar 6x6 serving as a troop transporter does.



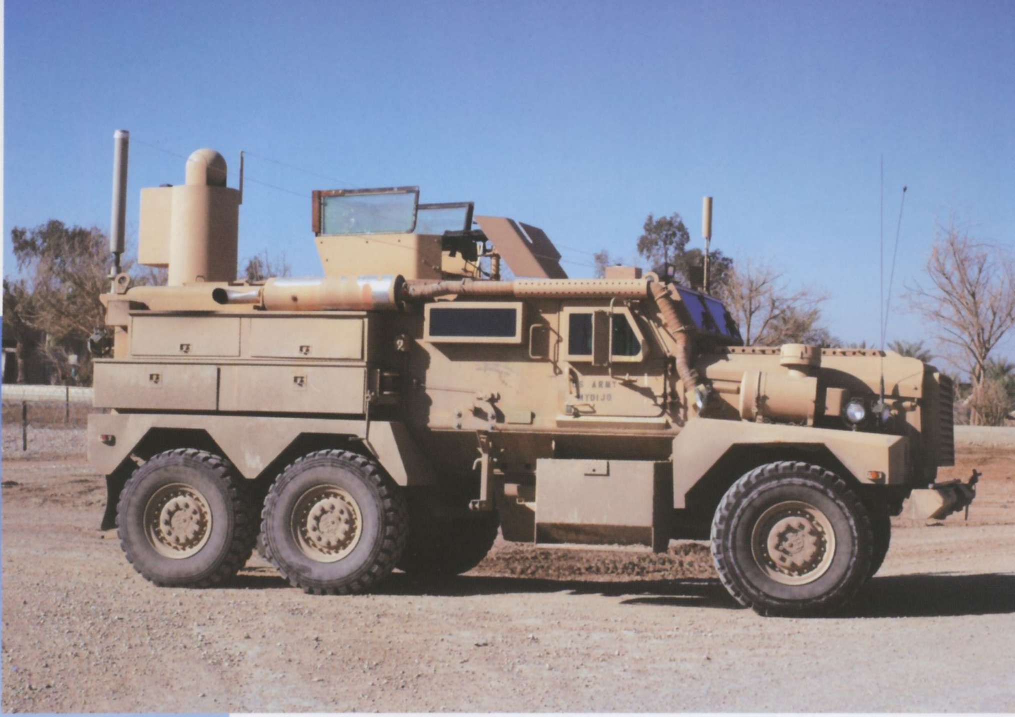
This Cougar 6x6 Category II MRAP belonging to an army EOD team was seen in eastern Baghdad in March 2007. Note that the vehicle has been fitted with additional slat armor on the driver's door. The spare wheel has also been replaced by a plate of steel armor to give more protection. It is believed both modifications were carried out by users to provide additional protection from Explosive Formed Penetrator IEDs, as well as from RPG-7s.

be forded without any preparation. Both versions of the Cougar MRAP can be fitted with a machinegun ring mount and it is also possible to mount a RWS. However, so far the author has not yet seen a Cougar MRAP fitted with an RWS in Iraq.

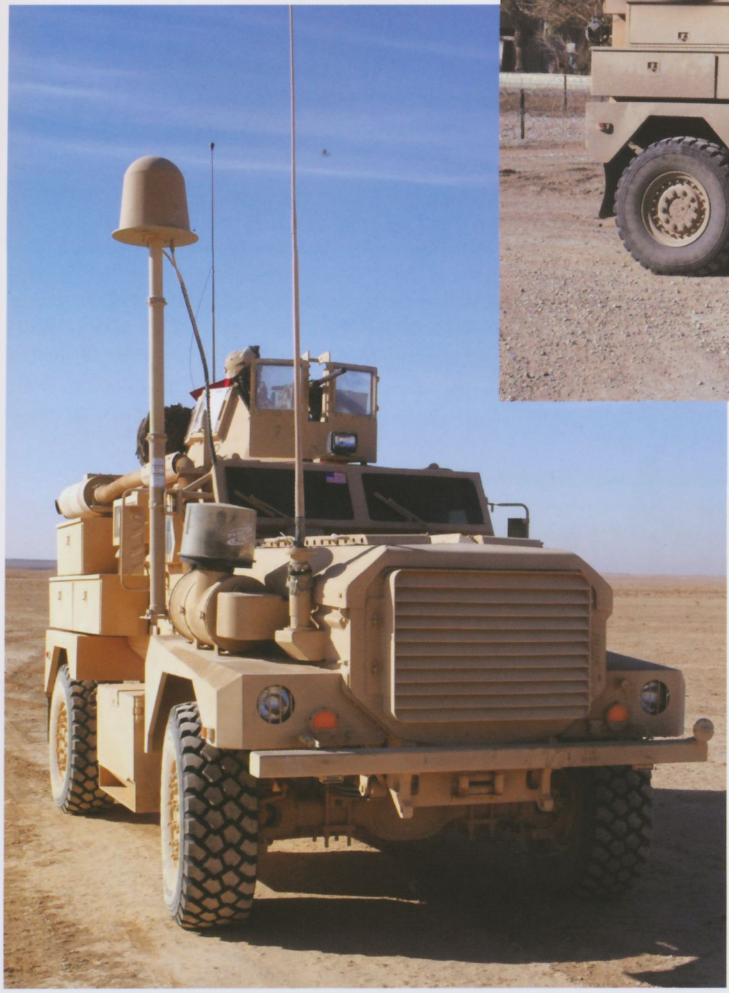
Combat Story

A general's point of view

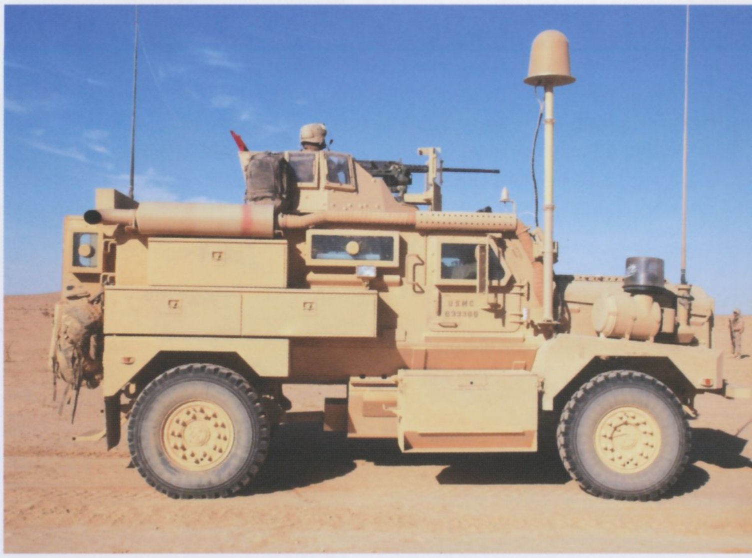
In hundreds of IED incidents, Cougar 4x4 and 6x6 vehicles have saved the lives of troops traveling in them. One of these incidents was described by the 34th and current Commandant of the USMC, General James T. Conway, in a speech at the Center for a New American Security on 15 October 2007. In the incident, a Cougar MRAP had been hit by an IED buried under the road surface. Later investigations revealed the IED contained some 135kg of explosive material. In this context it is interesting to note that during blast tests at Aberdeen Proving Ground, Cougars were only tested with charges of 22kg and 27kg. The IED exploded directly under the vehicle's engine bay. The Caterpillar engine was later found some 65m away, while other mechanical parts were ripped to pieces. In addition, the blast caused a complete reversal of direction on the part of the MRAP. According to the general, the four Marines traveling in the vehicle were not harmed and within a short period of time they were out on patrols again. The general stated: "The Cougar is an amazing vehicle in terms of the protection that it gives to our people against these types of underbody blasts."



The Cougar 6x6 MRAP Category II vehicle is 7.087m long, 2.743m wide and 3.302m high with the Gunner Shield. The pictured vehicle belongs to an engineer unit in Baghdad in March 2007.



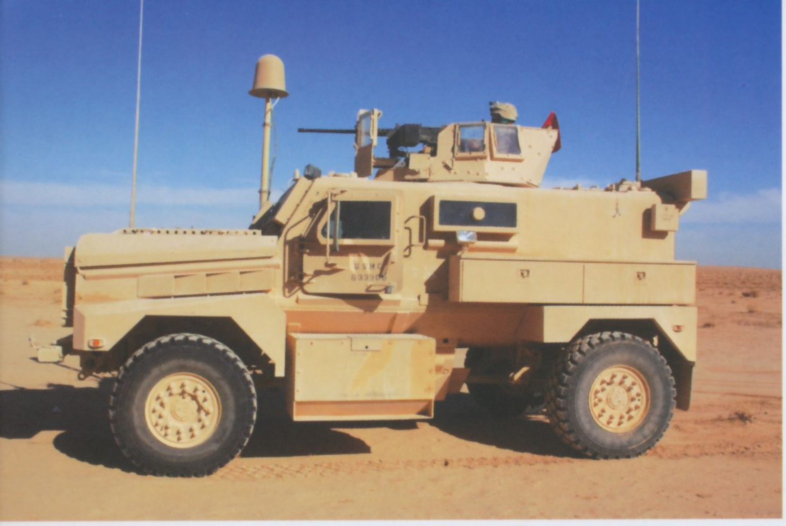
The ring mount of this vehicle is fitted with a 12.7mm M2 heavy machinegun. Note the Chameleon ECM system. Although this particular vehicle belongs to the USMC, the Cougar 4x4 MRAP also sees service with army units.



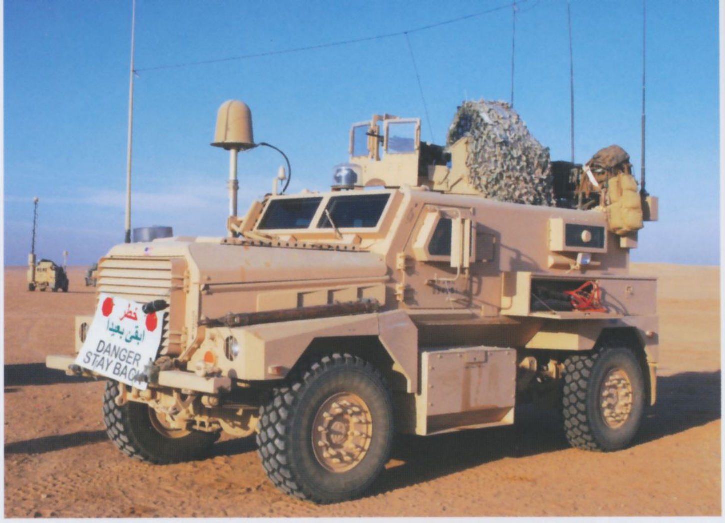
The Cougar 4x4 has a combat weight of 17,100kg and is 5.918m long. The rear compartment is 2.743m long. The pictured vehicle of the 3rd LAR Battalion seen in the Iraqi desert close to the Syrian border in January 2008 is fitted with a Gunner Protection Kit and TAGS.

Technical Data for Cougar 4x4 and 6x6

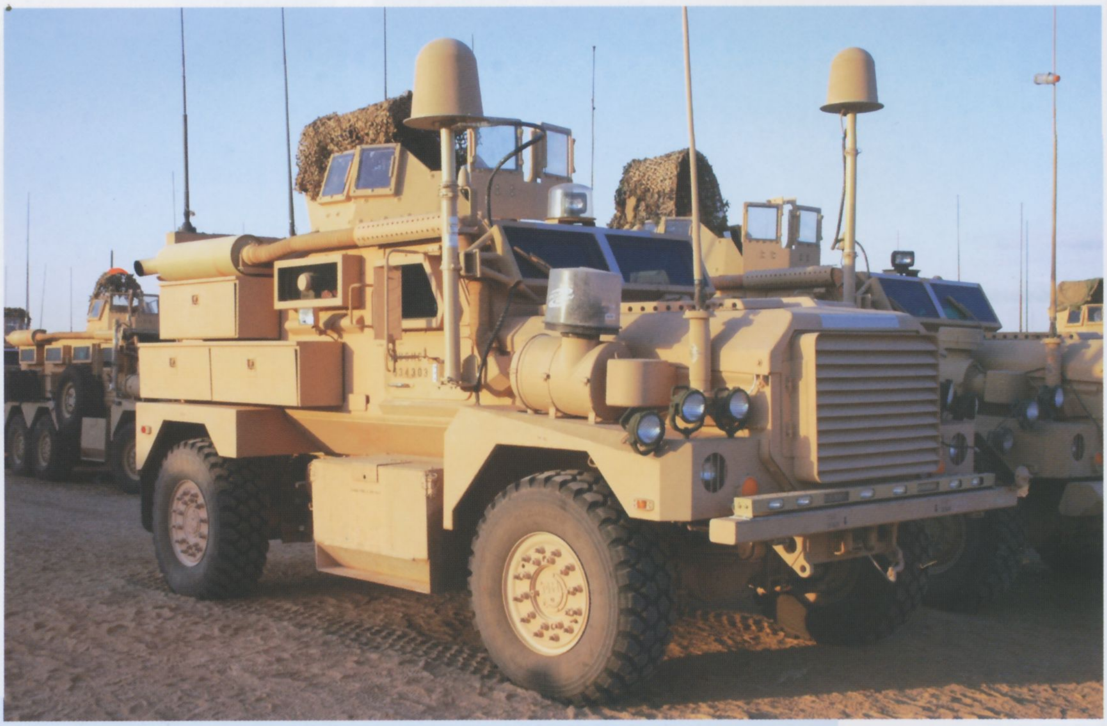
	Cougar 4x4	Cougar 6x6
Crew:	1+5 (driver plus five passengers)	1+9 (driver plus nine passengers)
Length:	5.918m	7.087m
Width:	2.743m	2.743m
Height:	3.302m with Gunner Shield	3.302m with Gunner Shield
Gross vehicle weight:	17,100kg	23,400kg
Curb weight:	14,400kg	17,550kg
Engine:	Caterpillar C-7 diesel engine developing 330hp at 1450rpm	Caterpillar C-7 diesel engine developing 330hp at 1450rpm
Transmission:	Allison 3500 SP automatic transmission	Allison 3500 SP automatic transmission
Maximum speed:	105km/h	105km/h
Road range:	676km	676km
Fording:	990mm	990mm
Ground clearance:	380mm	380mm
Approach/departure angle:	40°/50°	40°/50°
Electrical system:	24V	24V
Manufacturer:	Force Protection Incorporated	Force Protection Incorporate



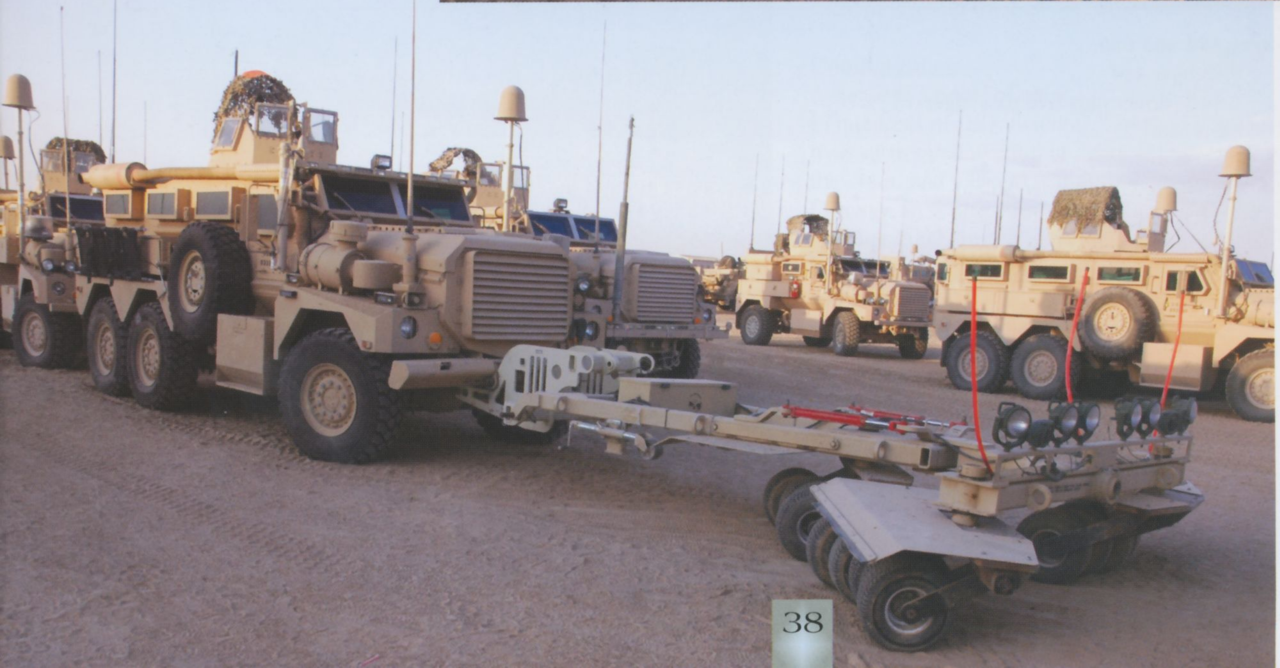
Like the Cougar 6x6 Category II MRAP, the Cougar 4x4 is powered by a Caterpillar engine and can be operated on and off road. The two fuel tanks are situated behind the front axle below the driver's and passenger's doors. Here the one on the left side is in view. The pictured USMC vehicle was seen during a patrol along the Syrian border in late 2007.



The first service to field the Cougar 4x4 Category I MRAP was the USMC in 2004. Since then the vehicle has been acquired in large numbers. Here a Cougar 4x4 can be seen providing security at a FOB in the Iraqi desert somewhere close to the Syrian border in December 2007. While the Cougar 4x4 can be operated on and off road, driving off-road can be a bumpy experience due to its high center of gravity and suspension system.



Here another Cougar 4x4 Category MRAP of a Marine trailblazer unit based at Camp Warhorse in Baqubah can be seen. To provide more white and infrared light for night operations, the vehicle has been fitted with several additional lights. Note also the electrically operated winch with a pull capacity of 4,050kg mounted under the front bumper.



This group of Cougar 4x4 and 6x6 MRAPs belongs to a Marine unit at Camp Warhorse in Baqubah in January 2008. The Cougar 6x6 MRAP in the foreground has been fitted with an IED-Roller designed to set off IEDs in front of the vehicle, thus rendering them harmless. In Iraq, USMC and U.S. Army units operate several different types of IED-Rollers in front of their Cougar MRAPs.

M88A1 Armored Recovery Vehicle and M88A2 HERCULES

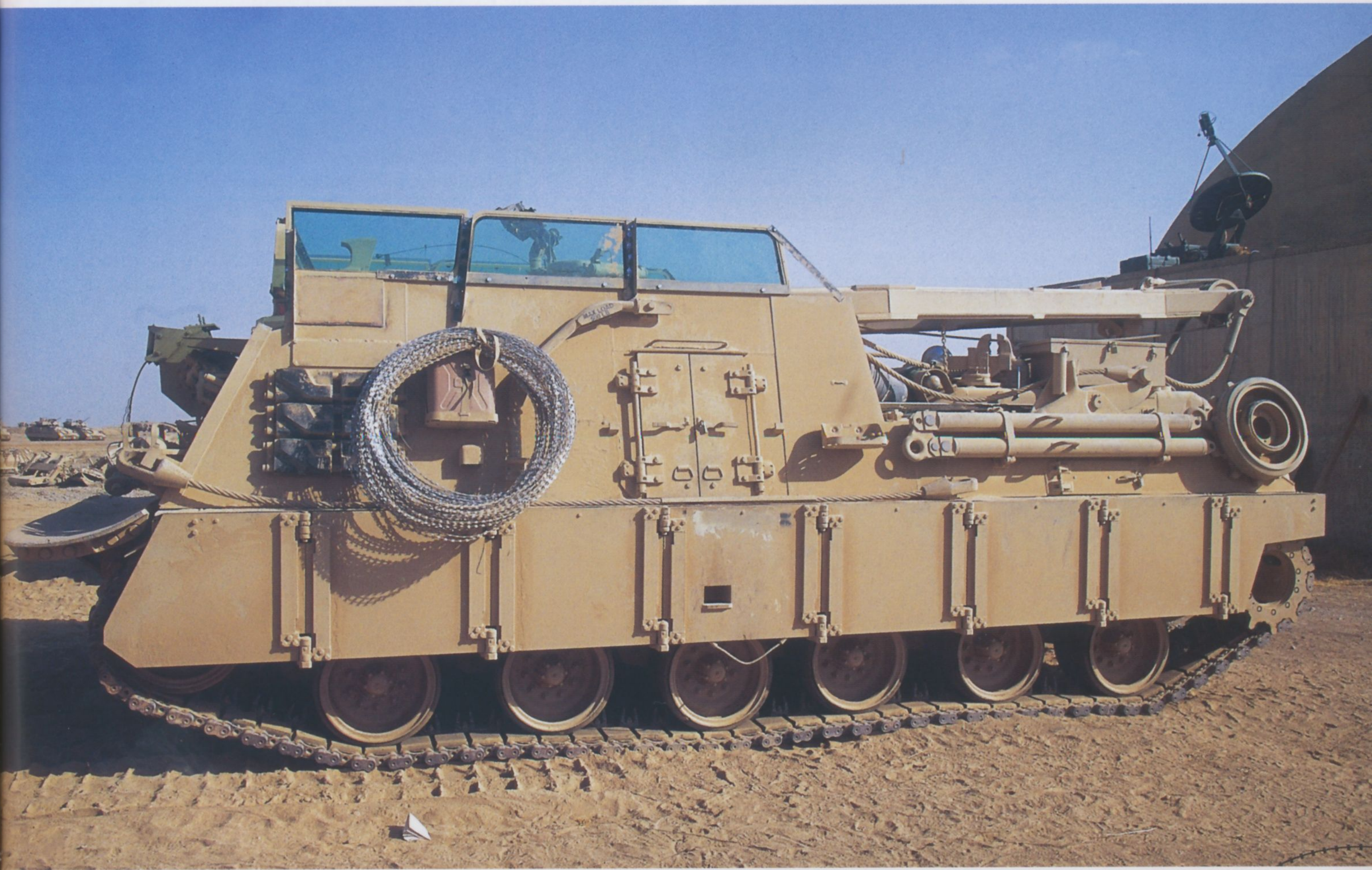
Currently the armored recovery capability of the U.S. Army is provided by the M88A1 Armored Recovery Vehicle (ARV) and its more modern brother, the M88A2 Heavy Equipment Recovery Combat Utility Lift and Evacuation System (HERCULES). Both types were deployed with army and USMC units during the initial Iraqi invasion, and at least two M88A2s were badly damaged during the fighting. Both vehicle types have served continually with American forces in Iraq since then, and have often seen action recovering disabled vehicles under fire. The M88A2 and M88A1 are both improved versions of the M88 ARV that entered service in 1961. The M88 featured many components in common with the M48 MBT.

In the 1960s and 1970s, the U.S. Army converted its tactical vehicle fleet from petrol to diesel engines. As part of this, a diesel-powered version of the M88 was developed and subsequently designated M88A1. Except for some minor modifications, the only major changes compared to the M88 were a redesigned hydraulic system, a new Continental AVDS-1790-2DR twelve-cylinder diesel engine developing 750hp, and an Allison XT-1410-4 transmission. The first M88A1 ARV entered service in the mid-1970s. In the early 1990s, some 2500 M88A1s were serving with the U.S. Army, ANG and USMC. The fleet included newly built M88A1s as well as M88s upgraded to M88A1 standard. But by then the M88A1 had reached its limits as it was simply not powerful enough to safely and effectively recover the M1 MBT that had entered service in the early 1980s, and which was much heavier than M48 and M60 tanks. Even worse was the fact that the steering and brake systems of the M88A1 could not safely handle the increased weight of the M88A1/M1 combination during towing operations. Due to the fact that the M1 tank's weight exceeded that of the M88A1 by some 15 tons, two M88A1 ARVs were needed to safely and effectively tow one M1 Abrams.

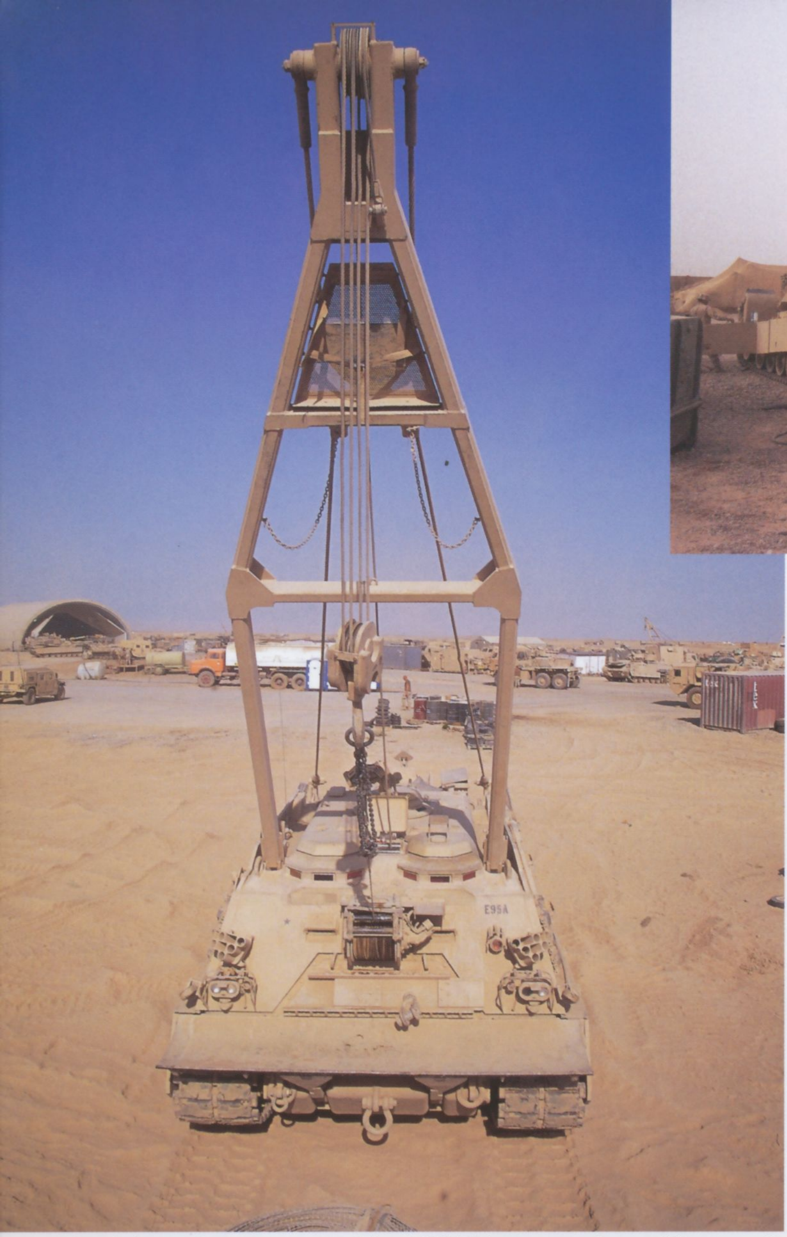
A more powerful armored recovery vehicle

As far back as 1981, the army started looking for a more powerful ARV. During tests in the late 1980s, a version of the M88A1 featuring a new and more powerful engine beat a newly designed ARV based on the M1 chassis. However, due to a lack of funding, the upgraded version of the M88A1 did not enter LRIP until 1994 and Full Rate Production in 1997. That same year the vehicle was officially type classified as M88A2 HERCULES. Production actually involved conversion of M88A1s into M88A2s, which was jointly conducted by United Defense LP and the Anniston Army Depot. The first M88A2s were fielded with units of the 1st Cavalry Division in July 1997. By 2007 the U.S. Army had received 157 M88A2s while the USMC had 55 vehicles in its inventory. In the 2008 budget, the conversion of another 100 M88A1s into M88A2s was funded. This still leaves the U.S. Army with a requirement for at least another 450 vehicles.

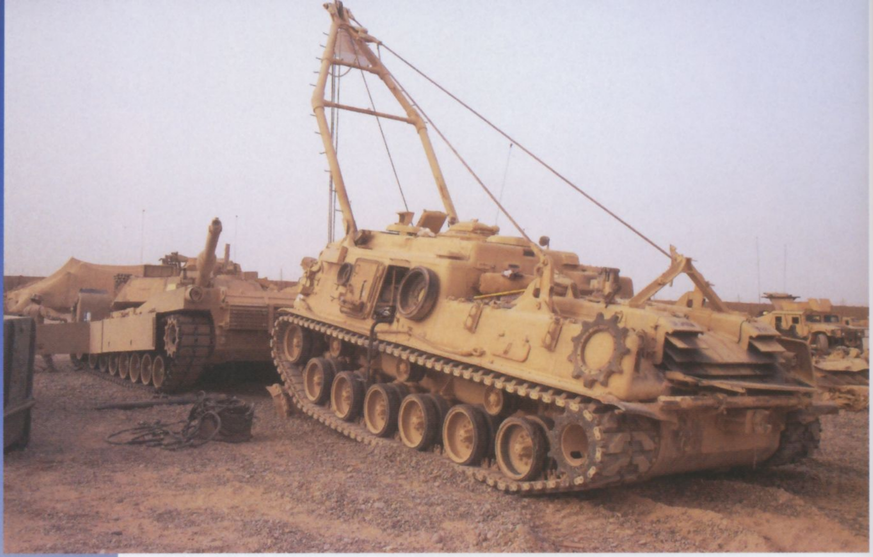
Compared to the M88A1, the M88A2 can lift up to 40% heavier loads with its crane and recover up to 55% heavier equipment with its winch. Its towing speed has been increased by 24% and its braking capacity by 25%. The M88A2 features a longer, totally redesigned A-frame boom crane with a maximum lift capacity of 31,750kg when the dozer blade is lowered to provide stability. At a reach of 2.4m, the crane can lift objects up to a height of 6.9m. The M88A2's new winch has a single-line continuous-pull capacity of 63,504kg, and a useable rope length of 85.3m. An auxiliary winch with a 201.2m-long cable and maximum pull capacity of 2700kg can be used to assist the deployment of the main winch cable. This allows the whole length of the heavy main winch cable to be used during recovery operations. Normally the main winch cable is deployed using a pulley and the cable of the auxiliary winch. The GDLS AVDS-1790-8CR air-cooled V12 diesel engine of the M88A2 develops 1050hp, whereas the older



The M88A2 HERCULES is the latest ARV version in service with the U.S. Army and USMC. The pictured M88A2 belongs to the 3rd Armored Cavalry Regiment and was seen in Tall Afar in the summer of 2005. Note that, in order to increase protection from small-arms fire, ballistic windshields from the HMMWV ASK have been mounted around the roof.



The A-frame boom crane of the M88A2 has a maximum lift capacity of 31,750kg. The crane has been completely redesigned and is much longer than that of the M88A1. The pictured M88A2 HERCULES belongs to the 3rd Armored Cavalry Regiment and was seen in Tall Afar in 2005.

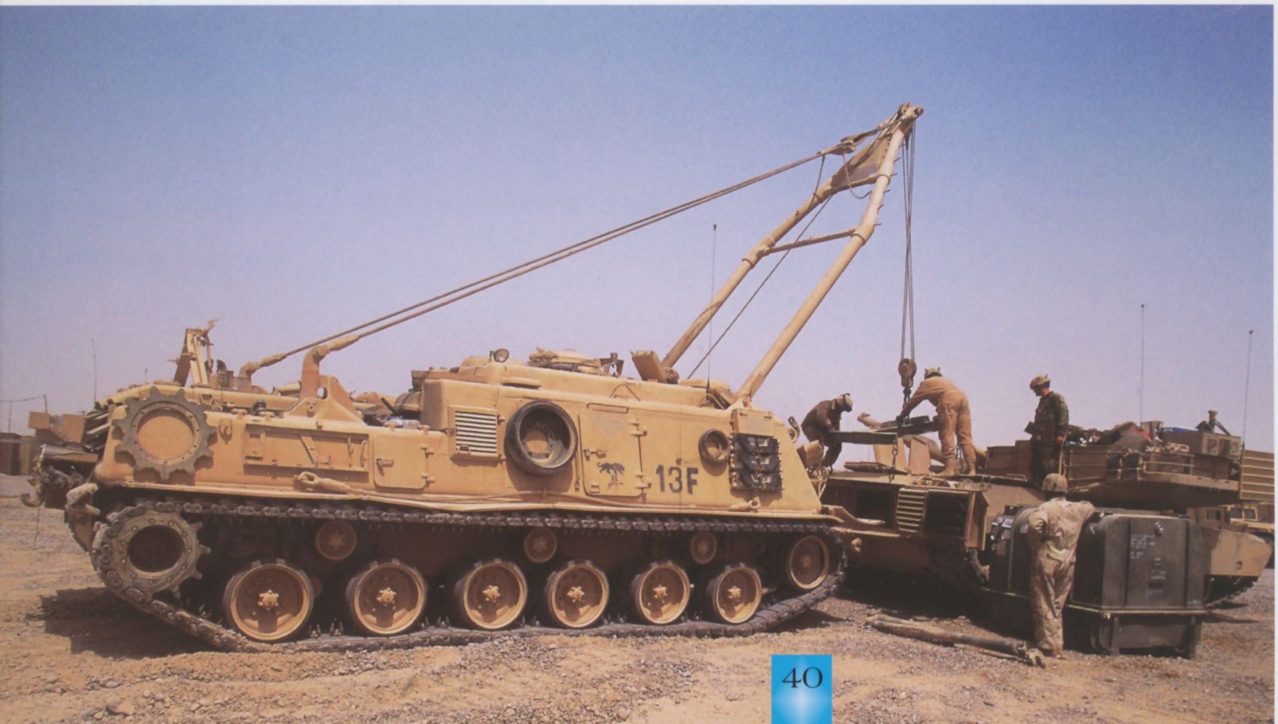


In addition to recovery missions, the M88A1 is employed for repair and maintenance work. In these two pictures an M88A1 ARV is helping change an engine pack of an Abrams. The A-frame boom crane has already been raised and the dozer blade lowered to provide the vehicle with a stable base. This M88A1 belongs to F Company, 3rd Battalion, 69th Armor Regiment, and was seen at FOB Brassfield-Mora outside Samarra in 2005.

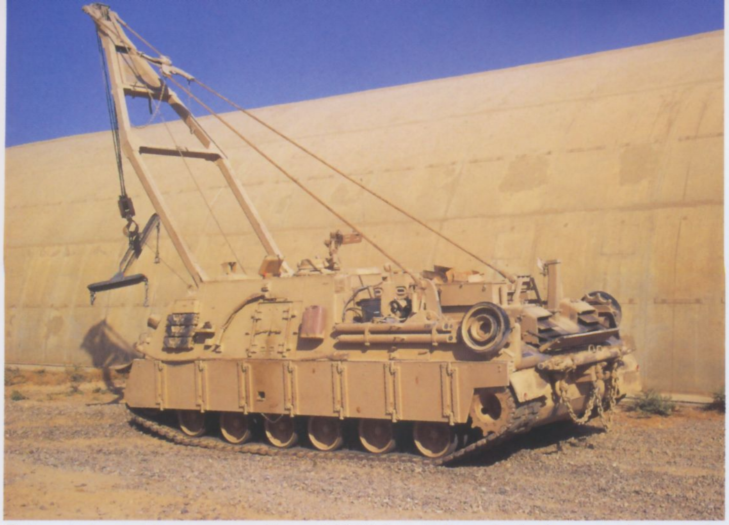
AVDS 1790-2DR diesel engine of the M88A1 develops only 750hp. The new engine and modified transmission allow the M88A2 to pull up to 25% heavier loads than the M88A1. The M88A2 also features superior armor compared to that of the M88A1. The M88A1 hull is partly constructed of cast armor steel and welded armor steel panels. During the M88A2 upgrade process, an additional layer of steel armor is installed onto this on the vehicle's front and sides. In addition, the M88A2 also features new armored side-skirts. According to United Defense LP, the M88A2's armor can withstand direct hits from 30mm armor-piercing rounds.

Only minor modifications

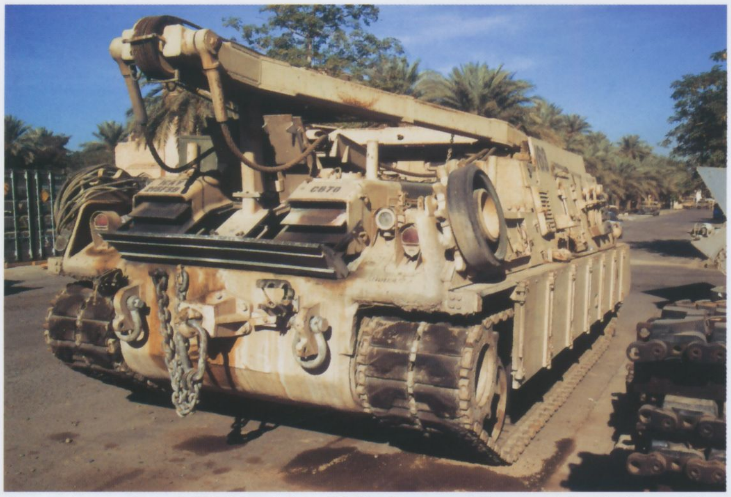
Despite the fact that M88A1s and M88A2s have seen action in Iraq, it appears only minor modifications have been made to enhance the protection of vehicle crews from the threat of small-arms fire and IEDs. One common modification includes installing blast shields around the roof of the crew compartment. In several cases these blast shields constructed at the unit level were made from windshield sections of bulletproof glass from the HMMWV Armor Survivability Kit (ASK). Other minor modifications include fitting gunner shields of the ACAV Kit to the mount of the commander's machinegun.



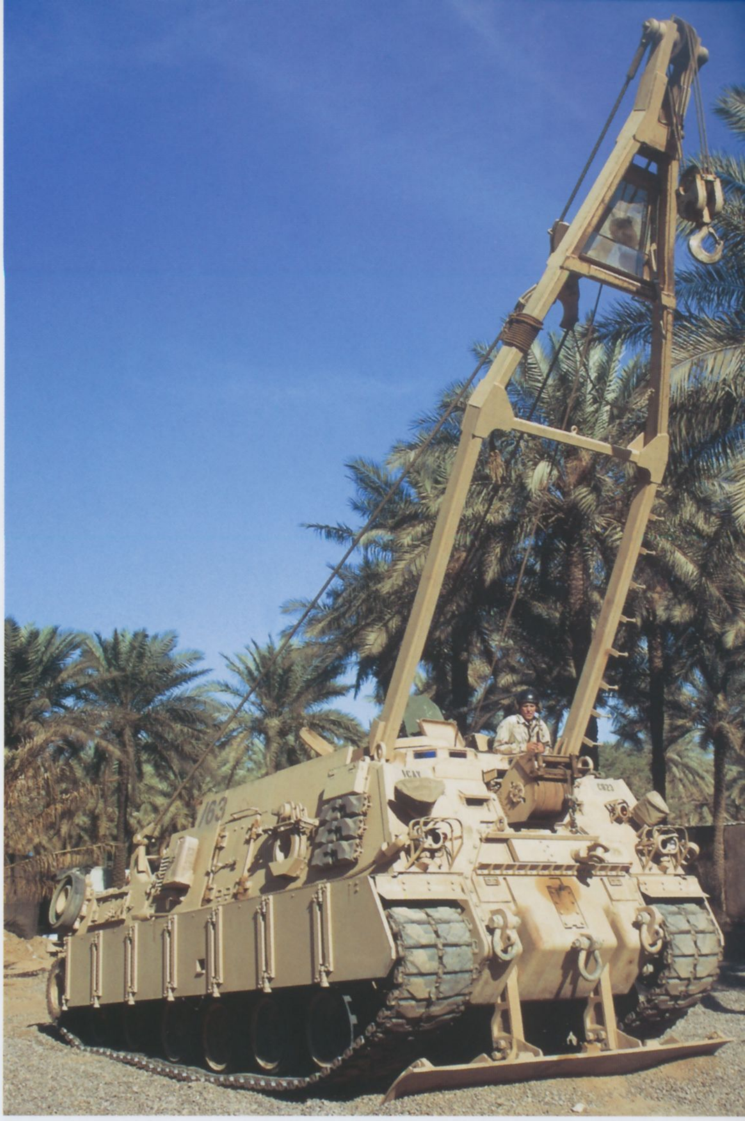
The M88A1 ARV has a combat weight of 50,803kg, and is 8.27m long, 3.43m wide and 3.12m high when the crane is not raised. The A-frame boom crane of the M88A1 has a maximum lift capacity of 22,700kg when the front-mounted spade is lowered. It can lift objects to a maximum height of 7.66m. The pictured vehicle belongs to F Company, 3rd Battalion, 69th Armor Regiment.



This picture shows another M88A2 of the 3rd Armored Cavalry Regiment. The A-frame boom crane has been raised and the crew is ready to conduct a power-pack change. The armored side-skirts, one of the survivability enhancements introduced on the M88A2, are visible.



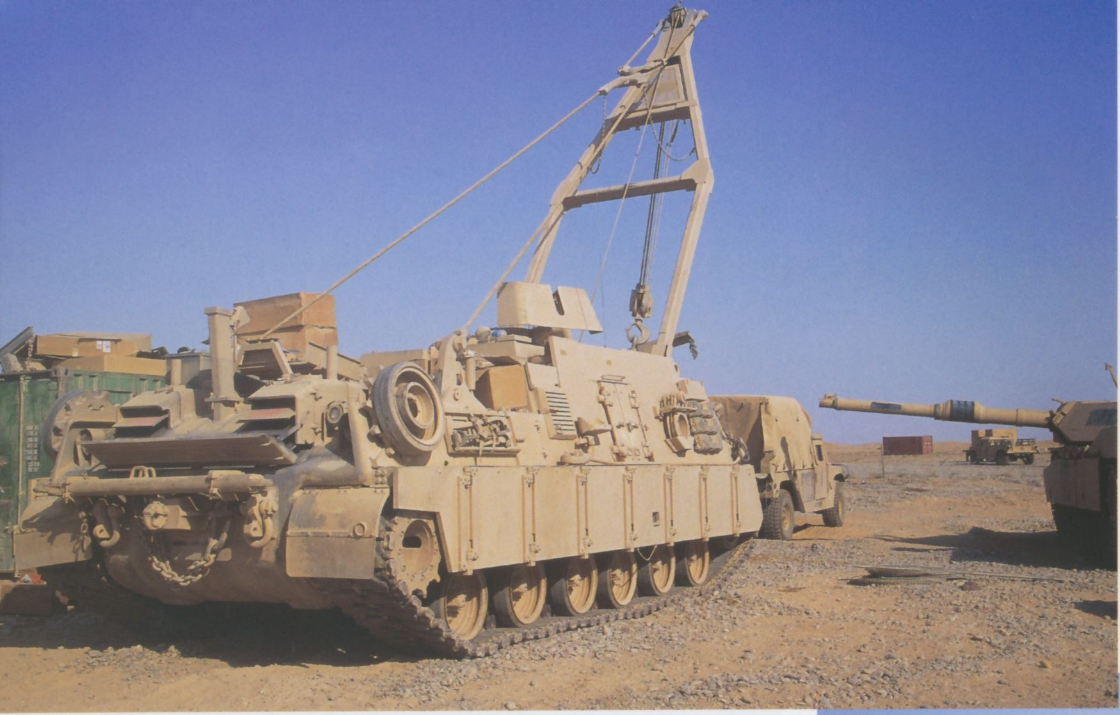
Rear view of an M88A2 of the 215th Forward Support Battalion of the 1st Cavalry Division. In view are the vehicle's exhausts. The GDLS AVDS-1790-8CR air-cooled V12 diesel engine, which develops 1050hp at 2400rpm, is mounted in the rear.



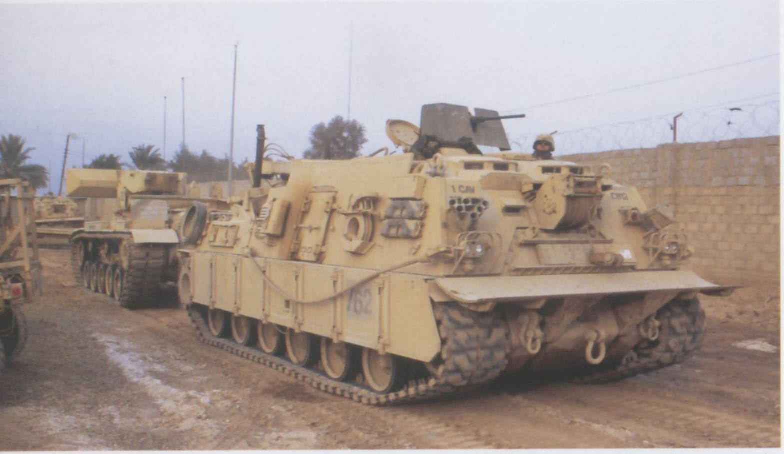
The A-frame boom crane of the M88A2 HERCULES has a lift capacity of 31,750kg when the dozer blade of the vehicle is lowered. Without using the dozer blade the crane's lift capacity is reduced to 22,680kg. This vehicle belongs to the 215th Forward Support Battalion of the 1st Cavalry Division, and was seen in the Green Zone in Baghdad in December 2004.

Technical Data for M88A2 HERCULES

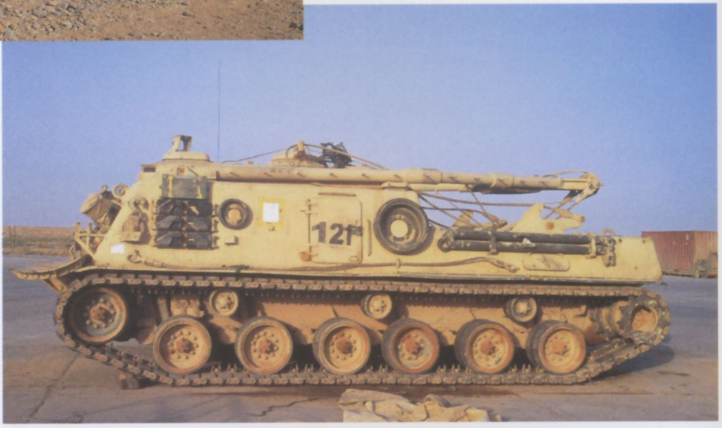
Crew:	3 (commander, driver and mechanic),
Length:	8.58m
Width:	3.67m
Height:	3.22m
Combat weight:	63,050kg
Engine:	General Dynamics Land Systems AVDS-1790-8CR air-cooled V12 diesel developing 1050hp at 2400rpm
Transmission:	Twin-Disc XT-1410-5A hydromechanical transmission with three forward and one reverse gears
Maximum speed:	40km/h
Fording:	1.422m
Ground clearance:	430mm
Fuel tank capacity:	1628 liters
Cruising range:	483km
Armament:	1x 12.7mm M2 HB commander's MG
Armor protection:	up to 30mm armor-piercing rounds
Vertical obstacle:	1.07m
Trench crossing:	2.62m
Gradient:	60%
Side slope:	30%
Recovery equipment:	A-frame boom crane with a maximum lift capacity of 31,750kg, dozer blade, main winch with single-line continuous-pull capacity of 63,504kg and useable rope length of 85.3m, auxiliary winch with a single-line pull capacity of 2700kg and usable rope length of 201.2m, onboard tool set including welding and cutting equipment
Manufacturer:	United Defense LP (today BAE Systems)



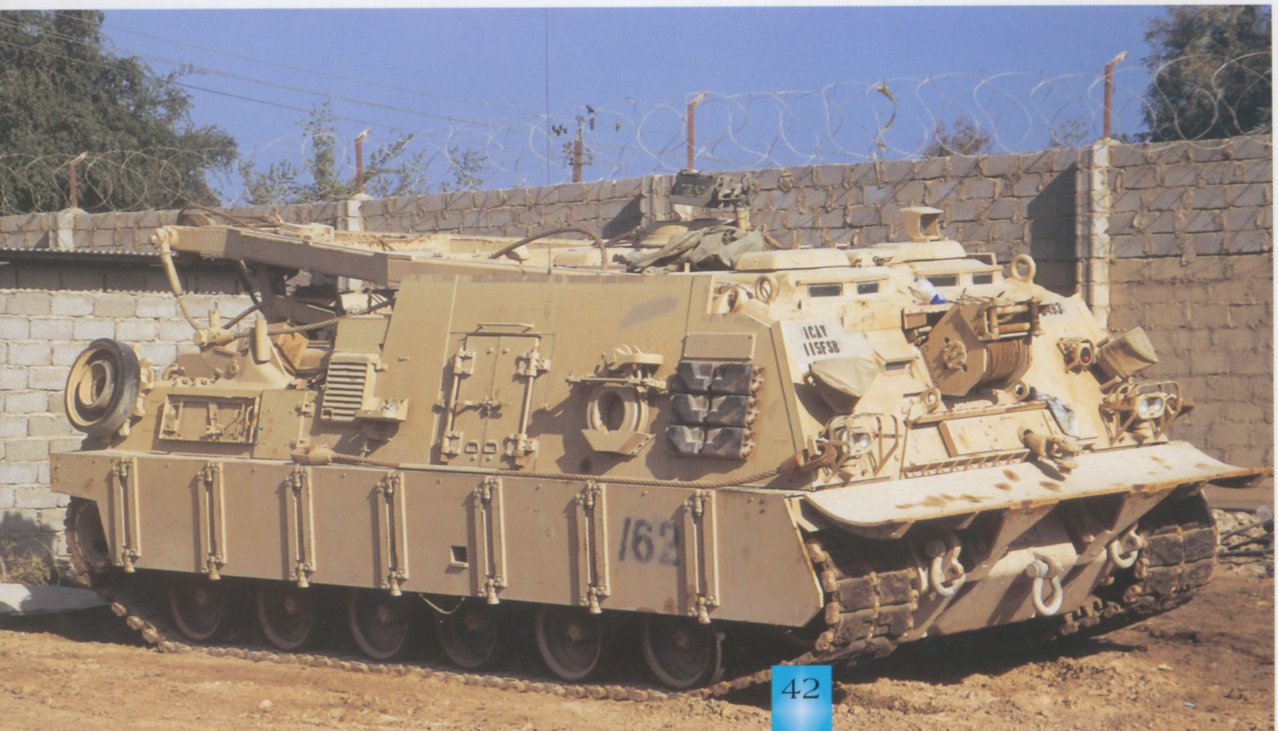
Another rear view of an M88A2 HERCULES. The vehicle belongs to a unit of the 3rd Armored Cavalry Regiment and was seen in Tall Afar in 2005. Note that the vehicle has been fitted with the gunner shield from an ACAV Kit.



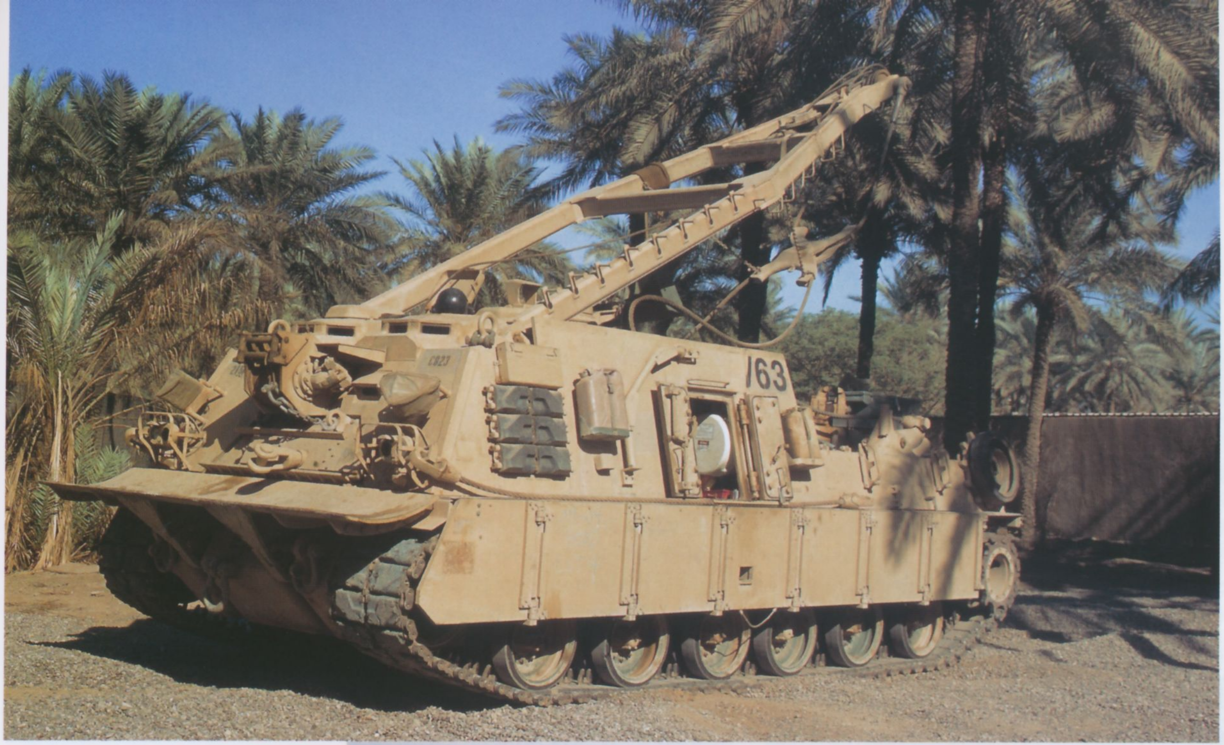
Here an M88A2 HERCULES can be seen fulfilling one of its primary tasks - recovery. The M88A2 is towing an M60A1 Armored Vehicle-Launched Bridge (AVLB) that has blown an engine. Note that this vehicle belonging to the 215th Forward Support Battalion seen in Baghdad in December 2004 is fitted with a gunner shield from an ACAV Kit.



Although the M88A2 HERCULES has already been in service for ten years, the bulk of ARVs in the army inventory are still M88A1s. It has a gross vehicle weight of 50,803kg, is 8.27m long, 3.43m wide and 3.12m high. The crew consists of the driver, vehicle commander and an additional mechanic. The M88A1 is powered by a Teledyne Continental AVDS-1790-2DR V12 diesel engine that develops 750hp at 2400rpm and allows a top speed of 42km/h. With a single tank of fuel the M88A1 has a road range of 483km. The engine is connected to a Twin-Disc XT-1410-4 hydromechanical transmission with three forward and one reverse gears.

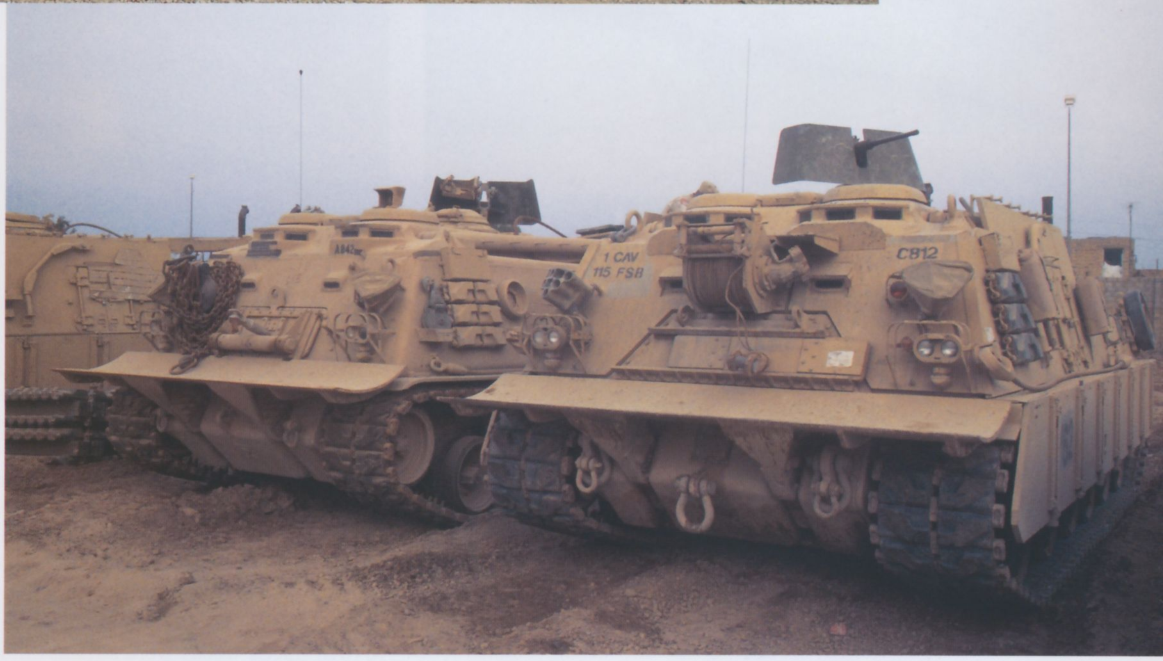


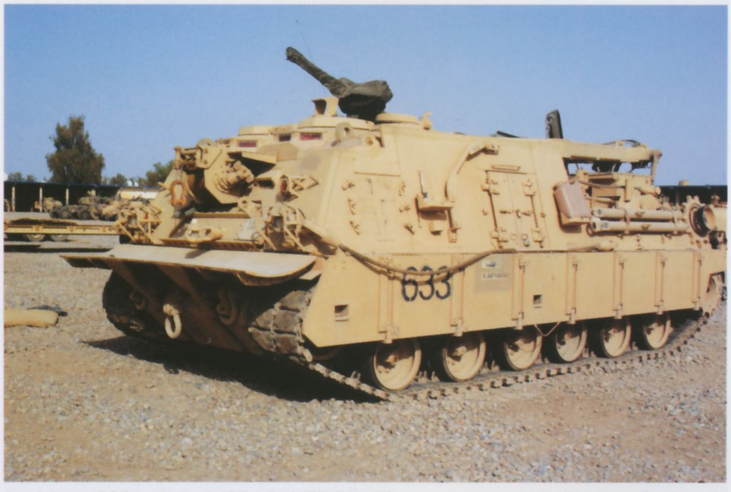
Another picture of an M88A2 HERCULES of the 215th Forward Support Battalion seen in eastern Baghdad in December 2004. The A-frame boom crane has been stowed in the traveling position. The vehicle markings include Unit Identification Markings, also called a bumper code, ("1CAV 115FSB C833") and the Combat Vehicle Marking System ("/63").



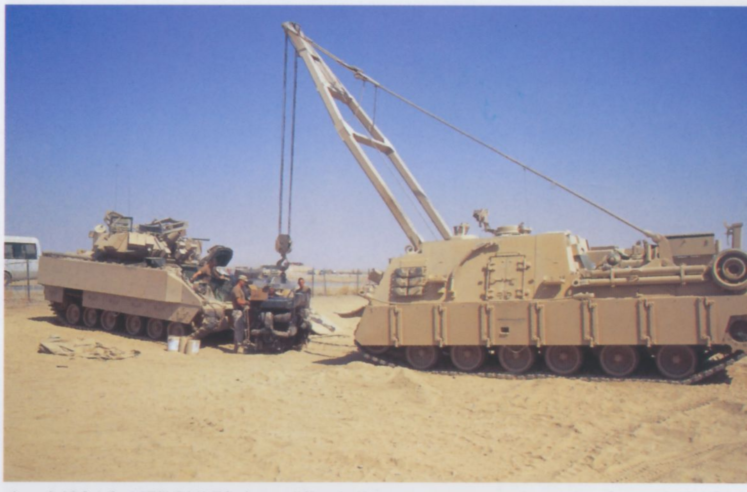
Here an M88A2 HERCULES of the 215th Forward Support Battalion can be seen deploying its A-frame boom crane. The vehicle might be one of the first ones built, as units of the 1st Cavalry Division were the first to be issued with the M88A2 in July 1997.

Compared to the M88A1, the M88A2 features a more powerful engine, new transmission, new power-assisted brake system, modified hydraulic system, improved suspension and improved armor package. The M88A2 is also fitted with an APU, a more powerful winch and a modified crane with extended boom and raised lifting capacity. The M88A2's combat weight is approximately 10,000kg higher than that of the M88A1. Here an M88A2 (right) and M88A1 (left) are seen side by side. The vehicles were seen in Baghdad in December 2004.





In May 2006, this M88A2 HERCULES was seen at Camp Gabe in Baqubah. The vehicle belongs to F Company, 1st Battalion, 68th Armor Regiment. Observe the vehicle's side-skirts and reinforced armor. Thanks to its heavy armor, the vehicle has a combat weight of 63,050kg.

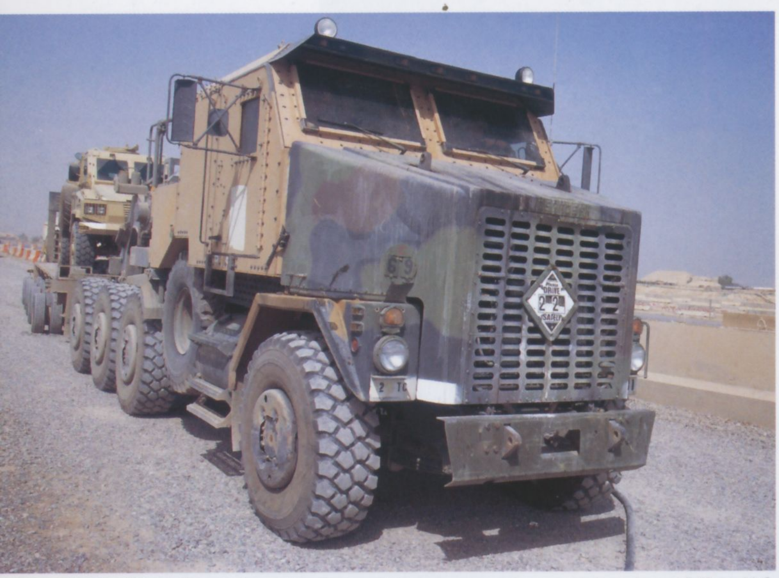


An M88A2 HERCULES has lifted the power pack out of an M3A2 Bradley with its A-frame boom crane. Both vehicles belong to the 3rd Armored Cavalry Regiment and were seen in the summer of 2005. Without lowering the dozer blade, the crane has a lifting capacity of 22,680kg, more than enough to lift this power pack

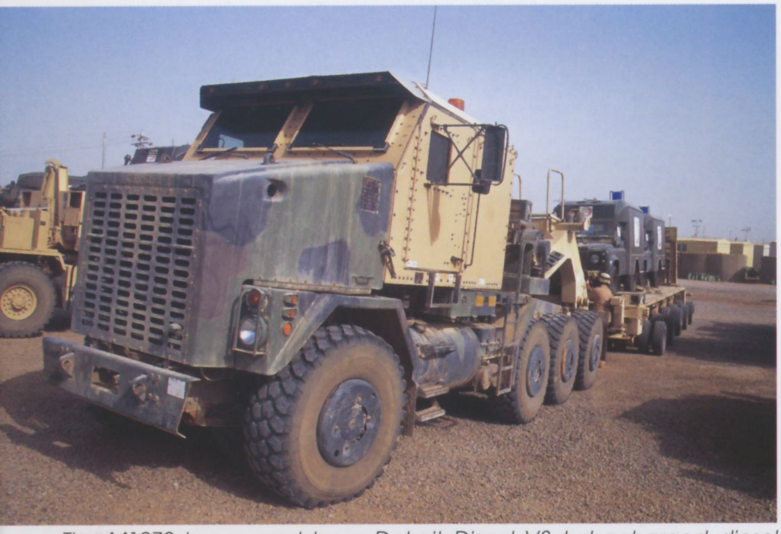
Heavy Equipment Transporter System

The Heavy Equipment Transporter System (HETS) is the prime tank and heavy equipment hauler of the U.S. Army. HETS are used to transport, deploy, recover or evacuate Abrams MBTs, as well as other heavy equipment weighing up to 63,500kg during administrative and tactical operations. The cab of the HETS offers space for the driver, co-driver and four passengers (a four-man Abrams crew, for instance).

The HETS consists of an M1070 8x8 truck tractor and M1000 70-ton low-bed rear-loading semi-trailer. The M1070 is manufactured by Oshkosh Truck Corporation and has a curb weight of 17,665kg. The vehicle is powered to a top speed of 72km/h by a Detroit Diesel 8V-92TA two-stroke V8 turbocharged diesel engine developing 500hp at 2100rpm. The engine is coupled to an Allison CLT-754 automatic transmission with five forward and one reverse gears. A two-speed Oshkosh 55000 transfer case allows the truck to be driven in high and low ranges. Rockwell SVI 5MR axles are used, the first and fourth steered via an Ackermann-type hydraulic steering system. The tractor's suspension system consists of parabolic-taper leaf springs on the front axle and air-ride suspension on the three rear axles. The service brake system is of the internal-shoe, dual-system type. The wheels consist of two-piece bolted steel rims and Michelin XZLT tires. Tire pressure is regulated via a Central Tire Inflation System (CTIS) that has settings for highway, cross-country, mud-sand-snow, as well as an emergency setting. The frame of the M1070 is bolted and made of heat-treated carbon manganese steel channel segments. The large oscillating fifth wheel can accommodate 89mm kingpins. To pull vehicles onto low-loader trailers, the M1070 features two dp-Manufacturing Model 55k two-speed recovery winches mounted on the left and right behind the crew cab. Each winch has a pull capacity of 24,947kg.



The HETS is the prime tank and heavy equipment hauler of the U.S. Army. The HETS can transport, deploy or evacuate all tactical vehicles in the army inventory. Here a HETS can be seen delivering a new RG-31 MRAP. Note that the HETS is fitted with a CPK.



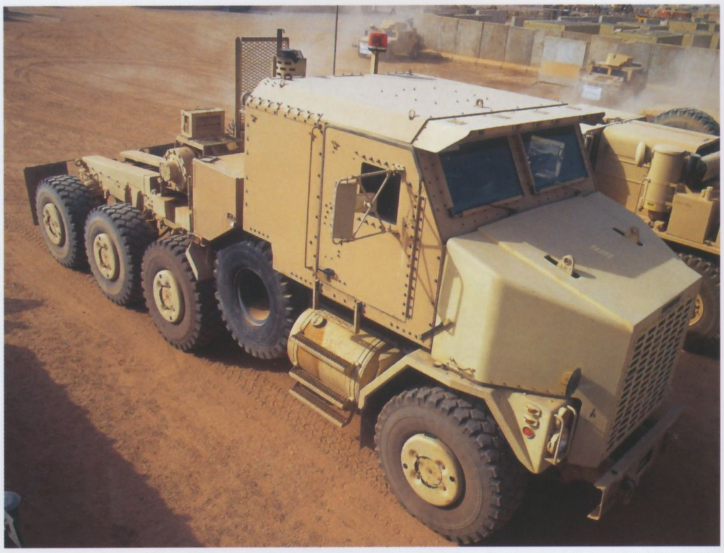
The M1070 is powered by a Detroit Diesel V8 turbocharged diesel engine that develops 500hp. The pictured HETS belongs to the 3rd Forward Support Battalion and was seen in Taji in August 2005. This M1070 is fitted with a CPK.

The M1000 70-ton semi-trailer is 15.9m long and 3.05m wide. It was specially designed by Systems & Electronics Incorporated to transport the Abrams MBT. The hydraulic suspension system allows the deck height to be adjusted by some 500mm (from 838mm to 1346mm) to make loading and unloading easier. When not connected to a tractor, the trailer's hydraulic system can be operated by an APU situated in the gooseneck. At the rear of the trailer are two 610mm-wide and 2.37m-long loading ramps. These can be adjusted between a minimum loading span width of 1.25m and a maximum of 3.45m. The semi-trailer is automatically steered and follows the path of the tractor. The M1000 semi-trailer's four rearmost axles are steered. When in tow, the semi-trailer can negotiate a 90° turn in one continuous motion at an intersection of two 9m-wide roads. The semi-trailer features an 89mm kingpin.

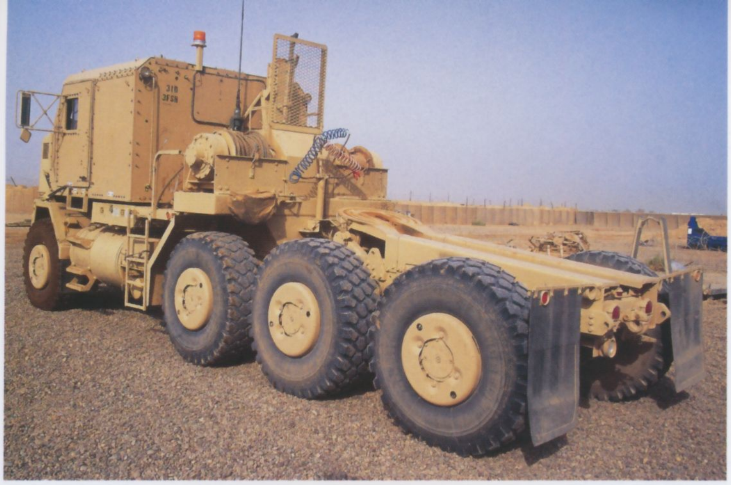
The HETS was selected by the army to replace the obsolete C-HET M911/M747 in 1990. According to official sources, the HETS entered service in 1993. Up till late 2006, some 2311 HETS had been delivered. The HETS has seen operational service in IFOR and SFOR contingents in Bosnia from 1996 onwards, with the KFOR contingent in Kosovo from 1999 onwards, and finally in OIF. Prior to the invasion of Iraq, hundreds of HETS were deployed to Kuwait to transport tanks, Infantry Fighting Vehicles (IFV) and other heavy equipment from ports to staging areas in the desert. During the ground-combat phase of OIF, the HETS fleet was kept busy transporting damaged equipment to maintenance establishments in the rear, shifting heavy forces on the battlefield, and bringing reinforcements forward. After the ground war had ended, the HETS fleet was used in the troop rotation process to transport heavy equipment and vehicles during deployments. In these operations, HETS convoys had to travel thousands of kilometers through insurgent-dominated terrain. Attacks on convoys, including HETS traveling north and south on convoy roads, took their toll on the truck fleet. Several HETS were lost to IED attacks and their crews killed or badly wounded.

Armor for the HETS

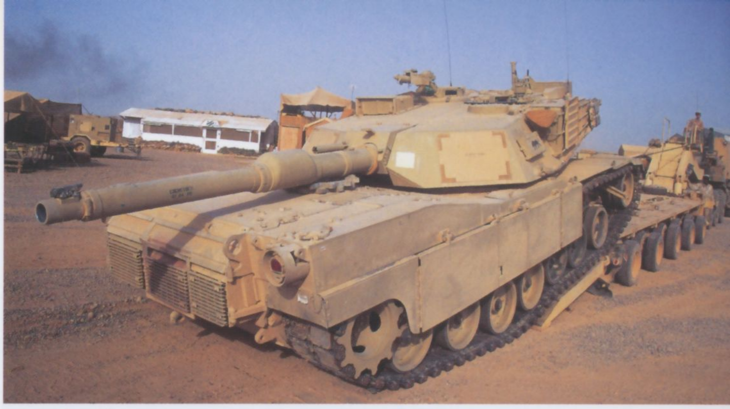
M1070 tractor trucks were initially fitted with Level III armor by crews at



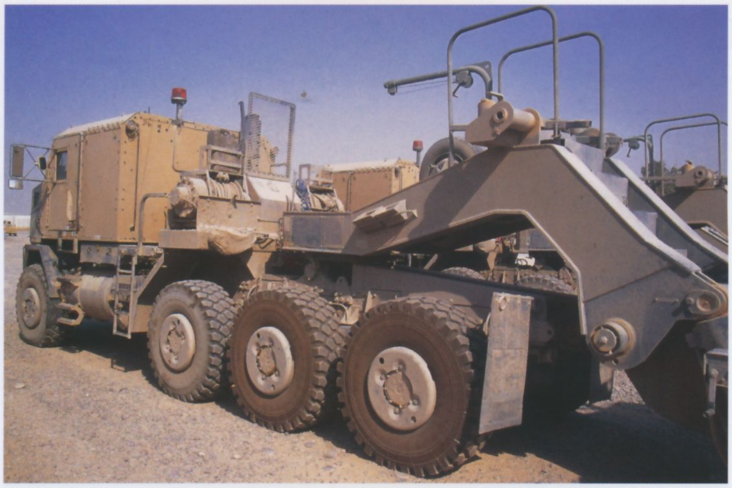
The CPK provides the crew and passengers traveling in the M1070 with improved protection from IED blasts and small-arms fire. The complete CPK weighs 1905kg.



Rear view of an M1070. Visible are the two dp-Manufacturing Model 55k two-speed recovery winches and the fifth wheel. The fully oscillating fifth wheel can accommodate 89mm kingpins with a kingpin load of up to 20,865kg. The vehicle belongs to A Company, 3rd Forward Support Battalion.



In the U.S. Army vehicle inventory, the HETS is the only tractor/semi-trailer combination in service that can haul Abrams tanks. Here a HETS can be seen loading a disabled M1A1 HA onto an M1000 70-ton low-bed rear-loading semi-trailer using its two dp-Manufacturing 55k winches. The picture was taken at LSA Anaconda in August 2005. By then, all four HETS of A Company "Gators", 3rd Forward Support Battalion, were fitted with CPKs.



The escape hatch in the rear armor panel is apparent in this view of an M1070 truck fitted with a CPK. The rear armor panel weighs 202kg, while the escape hatch weighs 38kg. Also visible is the gooseneck of the M1000 semi-trailer. The pivoting, hydraulically supported gooseneck equalizes the fifth wheel load and provides flexibility for grades and rough terrain.

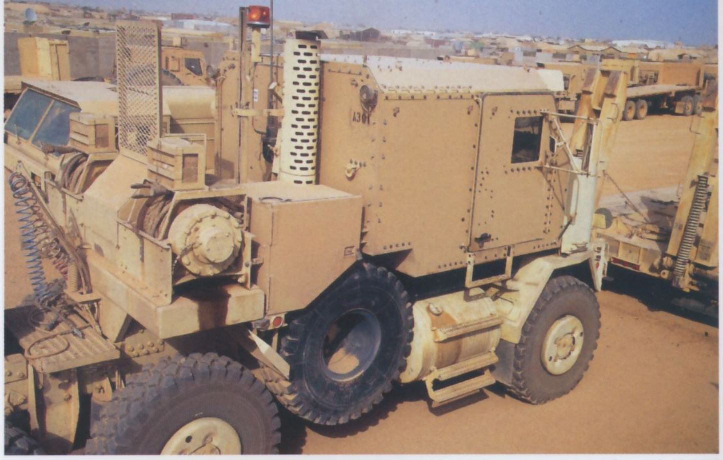
the unit level, often made out of scrap metal or using steel approved by the Headquarters Department of the Army. But by December 2003, development work had already started on Level II armor for the HETS. By October 2004, the HETS Crew Protection Kit (CPK) was ready for series production. While initial production was much lower, it was eventually ramped up to 225 kits per month. CPKs for the HETS were designed and produced by Simula Aerospace and Defense Group (today Armor Holdings Aerospace & Defense). In January 2005, all 591 HETS operating in Iraq and Afghanistan had been fitted with CPKs.

The1905kg CPK is mounted on the existing cab of the M1070 truck. Because some parts of the original cab are replaced by armored parts of the CPK, the truck's curb weight is only increased by 1677kg. The CPK consists of the following major components: left and right side armor, left and right door assemblies, left and right forward side armor, left and right rear side armor, left and right step armor, underbody armor (consisting of left, center and right blast deflectors, doghouse, and wheel-well armor panels), firewall armor panel, rear cab armor panel, roof armor panel, windshield ballistic glass, left and right side window ballistic glass, plus an armored escape hatch mounted in the rear cab armor panel. Like other add-on armor kits for trucks, the HETS CPK protects only the driver and passengers from IED attacks and small-arms fire; the engine and other vital vehicle parts are left unprotected.

Technical Data for Heavy Equipment Transporter System

Crew:	1+5 (driver and up to five passengers)
Length of M1070:	9.19m
Width of M1070:	3.66m (including mirrors)
Height of M1070:	3.56m
Length of M1000:	15.9m
Width of M1000:	3.05m
Curb weight of M1070:	17,665kg
Curb weight of M1000:	22,860kg
Gross combination weight:	104,963kg,
Maximum load capacity:	63,500kg
Engine:	Detroit Diesel 8V-92TA two-stroke V8 turbocharged diesel engine developing 500hp at 2100rpm
Transmission:	Allison CLT-754 automatic transmission with five forward and one reverse gears
Maximum speed:	72km/h
Fording:	710mm
Gradient:	15%
Side slope:	20%
Fuel tank capacity:	947 liters (in two separate tanks)
Cruising range:	523km
Other systems:	CTIS, 2x dp-Manufacturing Model 55k two-speed recovery winches each with a pull capacity of 24,947kg, dp-Manufacturing Model 3GN auxiliary winch with a pull capacity of 1360kg, fully oscillating fifth wheel accommodating 89mm kingpins
Manufacturer of M1070 tractor:	Oshkosh Truck Corporation
Manufacturer of M1000 semi-trailer:	Systems & Electronics Incorporated

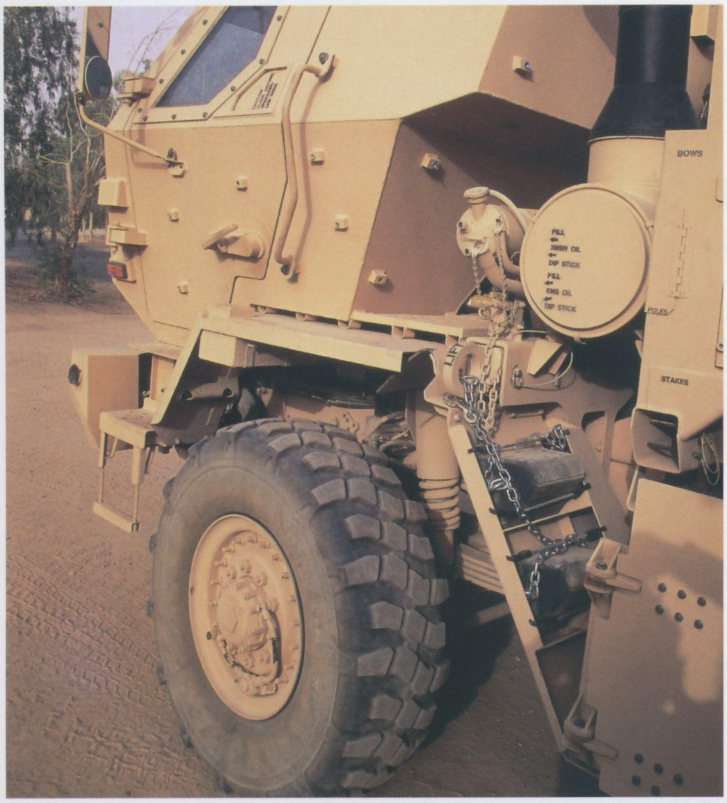
These three HETS have been loaded with the remains of a truck and tanker semi-trailer hit by an IED in a convoy. As a result of the explosion, the truck caught fire, the blaze quickly spreading to the tanker semi-trailer that had been punctured by splinters. For the HETS, which can carry loads of up to 63,500kg, the burnt remains are an easy load.



This close-up photo shows the right side of the crew cab of an M1070 fitted with a CPK. Apparent are the following CPK components: right door assembly weighing 150kg, right forward side armor panel weighing 11kg, and right rear side armor weighing 50kg. The roof panel that is visible has a weight of 184kg.

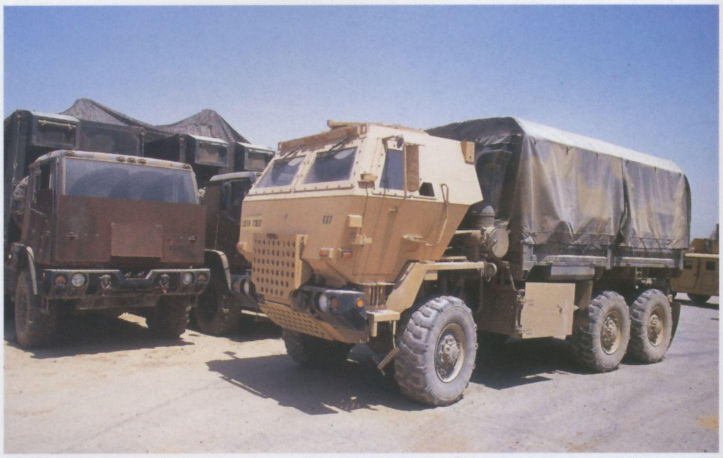
Family of Medium Tactical Vehicles

The Family of Medium Tactical Vehicles (FMTV) began entering service with U.S. Army units, initially with the 82nd Airborne Division, in 1996. FMTV trucks are based on the Austrian Steyr 12 M 18 design but they are manufactured by Stewart & Stevenson Tactical Vehicle Systems LP. In future, FMTV trucks will eventually replace all trucks of the aging M35/M44 2.5-ton truck series, M809 5-ton truck series, and M939 5-ton truck series. The FMTV consists of 4x4 trucks in the 2.5-ton payload class (called Light Medium Tactical Vehicle or LMTV) and 6x6 trucks in the 5-ton payload class (called Medium Tactical Vehicle or MTV). All FMTV variants are highly mobile and offer their drivers outstanding cross-country capabilities. These trucks are employed throughout the army in all kinds of units to perform line haul, local haul, unit mobility, unit re-supply and countless other missions. Most of the following FMTV variants are currently operated by the army in Iraq:

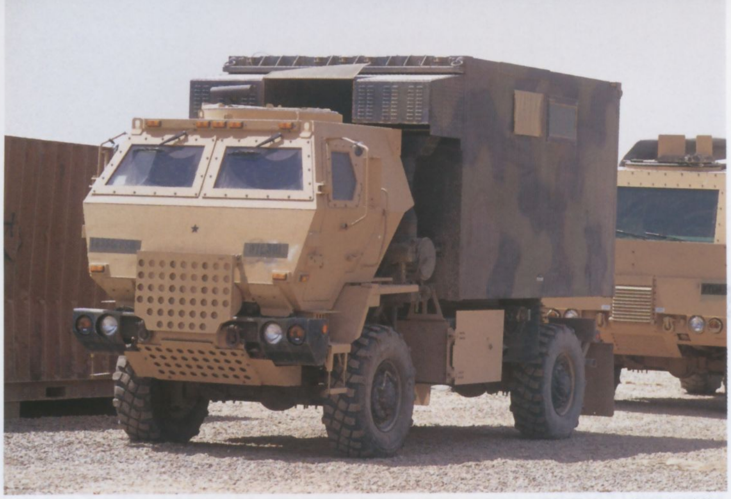


This detailed picture shows the driver's side of an LSAC on an FMTV truck. In addition, parts of the rear wall are also visible. Note that all walls of the LSAC are angled in order to deflect an explosive blast. The visible mounting points on the LSAC accommodate bolts onto which additional armor packages can be mounted.

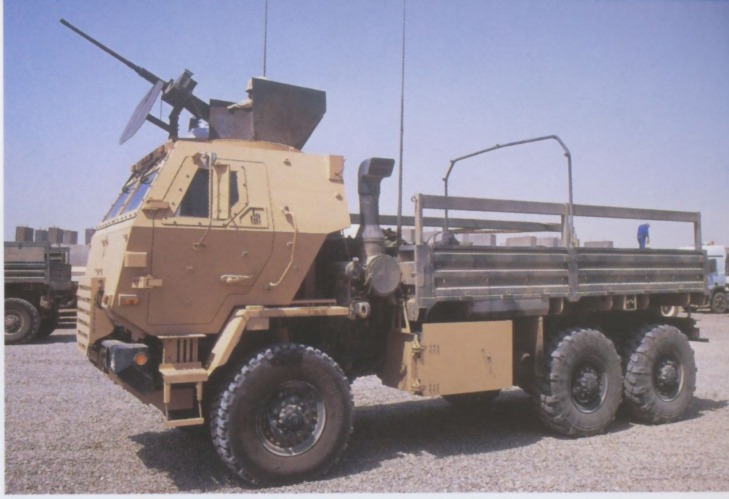
M1078A1/A1R LMTV 2.5-ton 4x4 drop-side cargo truck, 3.9m wheelbase, with or without winch
M1079A1/A1R LMTV 2.5-ton 4x4 truck van with or without winch
M1081A0 LMTV 2.5-ton 4x4 drop-side cargo truck, Low-Altitude Parachute Extraction System/Air Droppable with foldable cab, with or without winch
M1083A1/A1R MTV 5-ton 6x6 drop-side cargo truck with or without winch
M1084A1/A1R MTV 5-ton 6x6 drop-side cargo truck with material handling crane
M1085A1/A1R MTV 5-ton 6x6 drop-side cargo truck, long wheelbase, with or without winch
M1086A1/A1R MTV 5-ton 6x6 drop-side cargo truck, long wheelbase, with material handling crane
M1087A1R MTV 5-ton 6x6 expansible van
M1088A1/A1R MTV 5-ton 6x6 truck tractor with or without winch
M1089A1/A1R MTV 5-ton 6x6 wrecker
M1092A1 MTV 5-ton 6x6 dump truck with or without winch
M1093A0 MTV 5-ton 6x6 dump truck, Low-Altitude Parachute Extraction System/Air Droppable with foldable cab, with or without winch
M1094A0 MTV 5-ton 6x6 drop-side cargo truck, Low-Altitude Parachute Extraction System/Air Droppable with foldable cab, with or without winch
M1157A1R MTV 10-ton 6x6 dump truck with or without winch



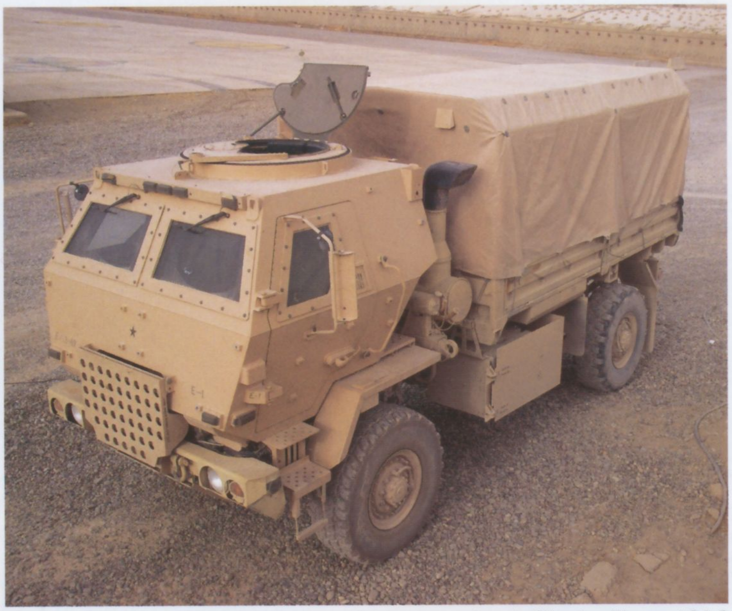
FMTV trucks initially deployed to Iraq were fitted at the unit level with improvised add-on armor kits made of HARDOX steel sheets bolted onto the original cab. This kind of add-on armor was officially called Level III armor and was considered an interim solution. The LMTV truck on the left sports such armor while the vehicle on the right has been fitted with Level I armor. Here the LSAC can be seen mounted on an M1083A1 MTV 5-ton 6x6 drop-side cargo truck. The picture was taken in the summer of 2005.



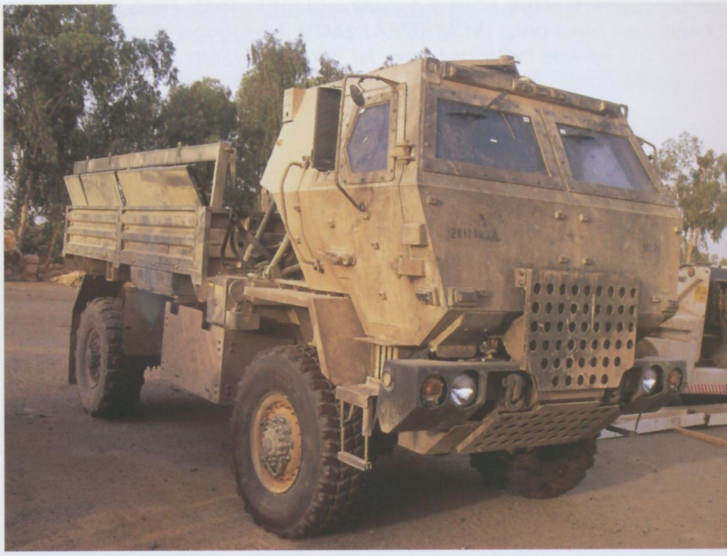
The LSAC can be mounted on all 2.5-ton and 5-ton FMTV variants. Like the FMTV itself, the cab was designed by Stewart & Stevenson Tactical Vehicle Systems LP. The LSAC is Level I armor that replaces the original cab. Made of High Hardness Steel, it has a weight of some 1500kg. Here the LSAC has been mounted on an M1079A1 LMTV 2.5-ton truck van.



A ring mount is located on the roof of the LSAC. Crew-served weapons such as the 12.7mm M2 pictured here can be mounted on it. Note the gunner shield made at the unit level and the armored box fitted to the ring mount that is supposed to provide some protection for the gunner. The pictured vehicle is an M1083A1 MTV 5-ton 6x6 drop-side cargo truck.



This M1078A1 LMTV 2.5-ton drop-side cargo truck fitted with an LSAC belongs to the 3rd Battalion, 69th Armor Regiment, and was seen on the outskirts of Samarra in August 2005. Note the ring mount on the cab roof, identical to that on M1114 Up-armored HMMWVs.



The LSAC of this M1078A1 LMTV 2.5-ton drop-side cargo truck still shows the scars of an IED attack. Apart from some cosmetic damage and a punctured tire, the vehicle was not seriously damaged. It belongs to the 1st Battalion, 103rd Armor Regiment of the Pennsylvania ANG, and was seen at Camp Summerall near Baiji in July 2005.

LMTVs and MTVs feature about 85% commonality of technical components. As with other soft-skinned vehicles, IED and small-arms attacks by insurgents in Iraq forced the army to fit FMTV trucks with add-on armor. While most FMTV trucks deployed in 2003-04 only featured Level III armor or no armor at all, by early 2008 almost all trucks sported Level II armored CPKs or Level I armored Low Signature Armored Cabs. According to a report by the DoD, the army was operating a fleet of some 3600 FMTV trucks in Iraq in late 2005. In 2007 this number was further increased under the "Surge".

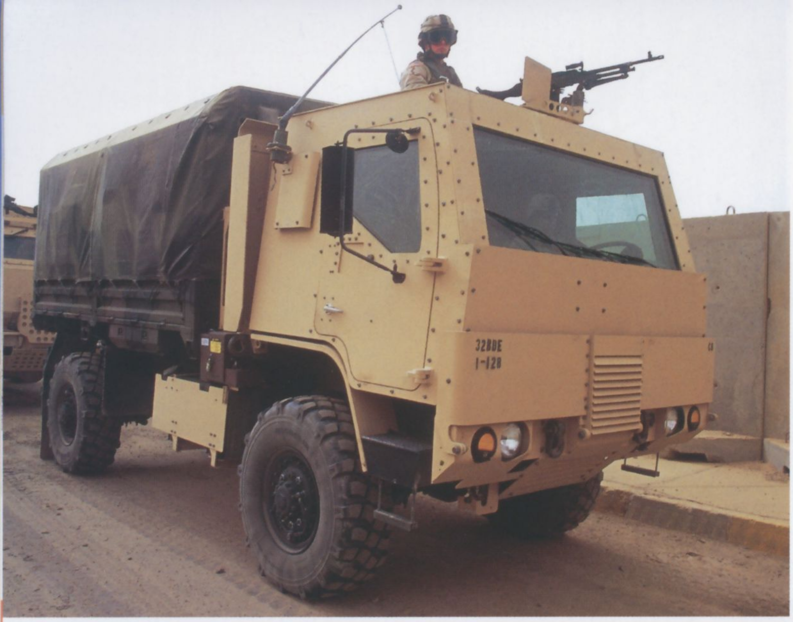
RADIAN Crew Protection Kit

The design of the FMTV CPK is based on a study of the Tank Automotive and Armaments Command that dates to well before the outbreak of the 2003 Gulf War. In April 2003, RADIAN (a subsidiary of Engineered Support Systems Incorporated) was tasked by the DoD to develop FMTV crew protection to series-production standard. In August 2003, two CPK prototypes were manufactured. These were mounted on an M1090A1 MTV 5-ton 6x6 dump truck and M1078A0 LMTV 2.5-ton 4x4 drop-side cargo truck that subsequently underwent mobility and blast tests. LRIP of 35 CPKs was conducted until February 2004, while full-rate series production began in April 2004. The first CPKs were mounted on FMTV trucks in Iraq in June 2004. While the initial order placed by the DoD was for 272 CPKs, some 1857 were ordered by early 2005 and further orders followed.

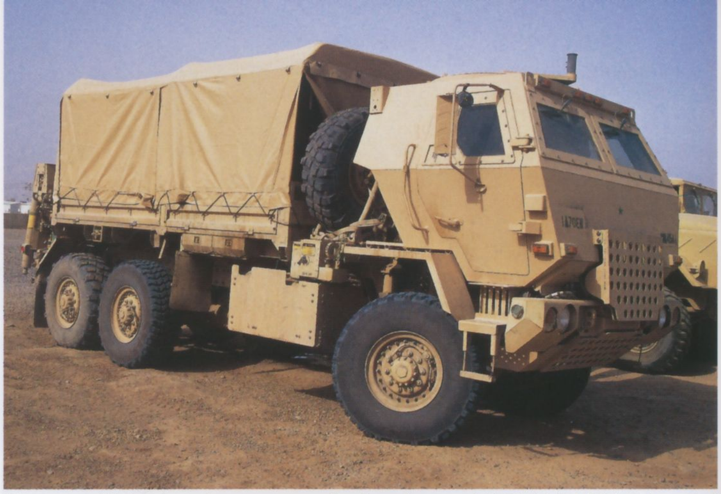
The CPK, because it was designed by RADIAN, is sometimes also called RACK (RADIAN Armor Crew Kits). It is mounted on the original crew cab of the FMTV and provides 360° protection for the crew from small-arms fire and blasts from mines, IEDs and artillery shells. The CPK is made of High Hardness Steel and features windows of 75mm-thick ballistic glass. Including all fasteners, air-conditioning system, parts for enhancing the suspension, armor for the battery box and fuel tank, and the machinegun turret mount, the CPK consists of 2275 parts and has a weight of 2340kg. Because some parts of the original cab are replaced with CPK parts, it only adds 2115kg to the truck's curb weight. Mechanics who fitted CPKs at U.S. bases in Iraq explained that mounting the complete CPK and air-conditioning system takes 56 man hours. The CPK can be mounted onto cabs of nearly all members of the FMTV. If the CPK is no longer required, it can be removed without causing any damage to the original cab. Due to the fact that the CPK is mounted onto the existing cab, it is classified as Level II armor under the Vehicle Hardening Program.

Low Signature Armored Cab

In contrast to this, the Low Signature Armored Cab (LSAC) is classified as Level I armor under the Vehicle Hardening Program. When the LSAC is



The CPK designed and manufactured by RADIAN is a Level II armor kit mounted onto the existing cab of FMTV trucks. In addition to the crew, it also protects some core automotive components. Here the CPK has been mounted onto an M1078A1 LMTV 2.5-ton 4x4 drop-side cargo truck. The vehicle belongs to the 1st Battalion, 128th Infantry Regiment of the Wisconsin ANG, and it was seen in Iraq in 2005.



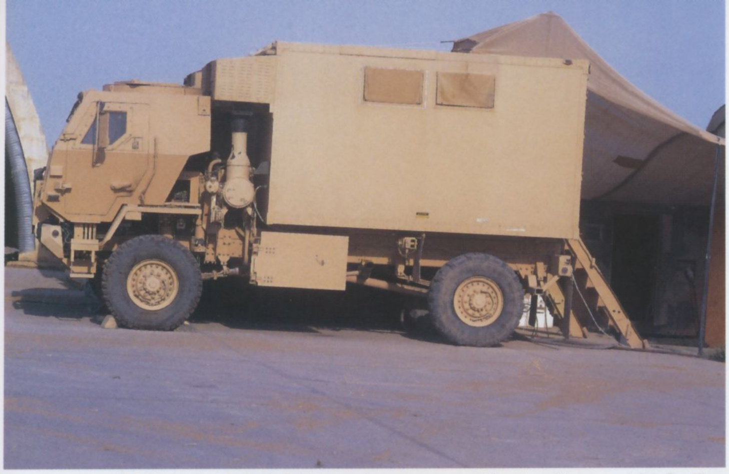
Here an LSAC has been mounted onto an M1084A1 MTV 5-ton 6x6 drop-side cargo truck. The M1084A1 features a Grove material handling crane with a maximum lift capacity of 2270kg at a boom extension of 2.1m. This vehicle belongs to the 70th Engineer Battalion and was seen in July 2005.

fitted, it replaces the whole cab of the FMTV truck. According to documents of the National Defense Industrial Association, development of the LSAC had already begun in October 2002. Work was jointly conducted by Stewart & Stevenson Tactical Vehicle Systems LP and O'Gara-Hess & Eisenhardt (today both companies are subsidiaries of BAE Systems). In July 2003 a prototype two-man cab was completed and tested. With the launch of the Vehicle Hardening Program, development of the LSAC accelerated. Due to the requirements of the U.S. Army, development now focused on a three-man cab, with a first prototype built in April 2004. Only a month later the army began testing the new LSAC. After successful tests and final development to series-production standard, the army placed its first order for an initial production of 385 LSACs on 24 November 2004. Fielding of the first LSACs began in December. By mid-2005, some 300 LSACs were being manufactured monthly.

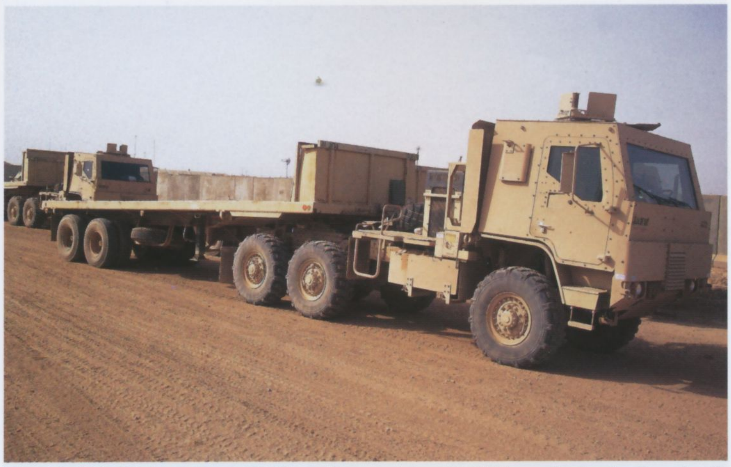
Today more than 2000 FMTV trucks operated by the army in Iraq and Afghanistan have been fitted with Level I add-on armor. A statement from BAE Systems claims that replacing the original cab with the LSAC takes a two-man team only four hours. The LSAC weighs approximately 1500kg and is made from High Hardness Steel with windows of ballistic glass. The LSAC provides the vehicle crew with 360° protection from small-arms fire up to a caliber of 7.62mm (even when armored-piercing rounds are used), as well as blast effects and shrapnel from mines, IEDs and artillery shells. The LSAC also comprises armor panels that protect certain automotive components such as the fuel tank and battery box. The LSAC does not affect the dimensions of the vehicle and increases its weight by only a small amount. As a result, FMTV trucks maintain an air-transport capability in C-130 transport aircraft, something not possible when an FMTV is fitted with the RADIAN CPK.

Technical Data for LMTV and MTV

	M1078A1 LMTV 2.5-ton drop-side cargo truck with or without winch	M1083A1 MTV 5-ton drop-side cargo truck with or without winch
Crew:	1+2	1+2
Length:	6.534m	7.206m
Width:	2.438m	2.438m
Height:	2.845m	2.845m
Payload:	2268kg	4536kg
Curb weight:	7808kg	9433kg
Engine:	Caterpillar C7 electronic controlled, turbocharged 6-cylinder JP-8/diesel engine developing 275hp at 2200rpm	Caterpillar C7 electronic controlled, turbocharged 6-cylinder JP-8/diesel engine developing 330hp at 2400rpm
Transmission:	Allison 3700SP electronically controlled automatic/ select seven-speed transmission	Allison 3700SP electronically controlled automatic/ select seven-speed transmission
Maximum speed:	94km/h	94km/h
Road range:	645km	483km
Fording:	762mm	762mm
Ground clearance:	365mm	365mm
Approach/departure angle:	40°/37°	40°/49°
Cargo bed dimensions (length x width):	3.784m x 2.311m	4.318m x 2.311m
Electrical system:	12/24V	12/24V
Wheelbase:	3.9m	4.1m
Manufacturer:	Stewart & Stevenson Tactical Vehicle Systems LP (today Tactical Vehicle Systems Division Aerospace, Defense Group of Armor Holdings)	Stewart & Stevenson Tactical Vehicle Systems LP (today Tactical Vehicle Systems Division Aerospace, Defense Group of Armor Holdings)

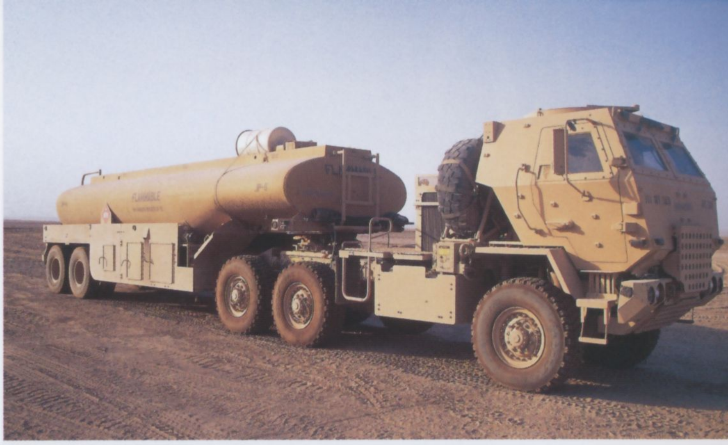


This is an M1079A1 LMTV 2.5-ton truck van fitted with an LSAC. The shelter can be used to house workshops or communication equipment. The pictured vehicle belongs to the 3rd Armored Cavalry Regiment and was seen at Tall Afar Airbase in August 2005.

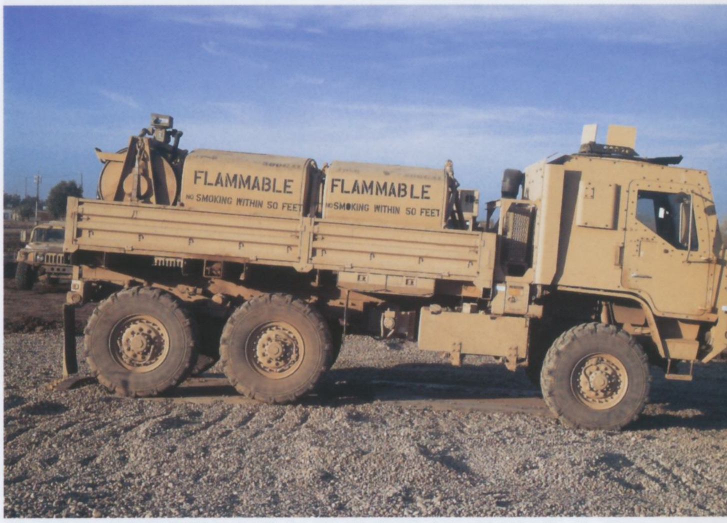


The FMTV CPK weighs 2340kg. It consists of 2275 parts, including bolts and fasteners. In addition to the cab armor, the CPK includes armor plates for the fuel tank and battery box, an air-conditioning system and enhancements to the vehicle suspension. Because the original cab doors and windshield are removed, the kit only increases the curb weight by 2115kg. Here the CPK is mounted on an M1088A1 tractor truck of the 3rd Forward Support Battalion.

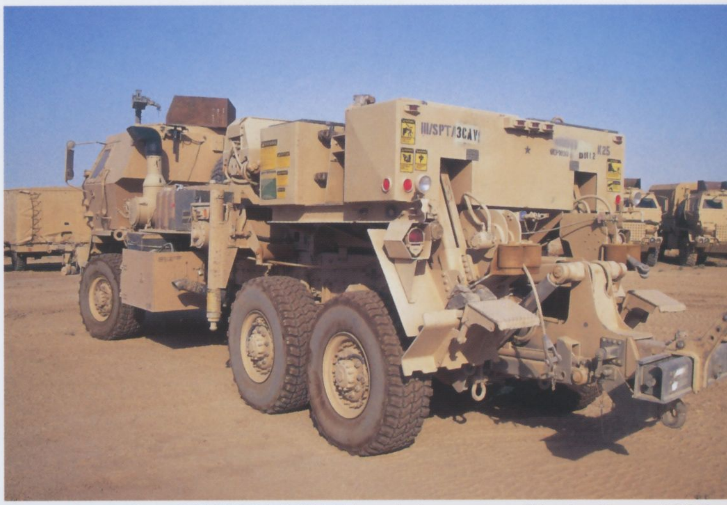
An army convoy moves down MSR Tampa in the vicinity of Tikrit. The area is only one in which ambushes and IED attacks occur regularly. In order to protect truck drivers and passengers, the army launched the Vehicle Hardening Program under which trucks like the FMTV were fitted with appliqué armor. The pictured M1088A1 MTV 5-ton 6x6 tractor trucks have been fitted with CPKs designed and manufactured by RADIAN.



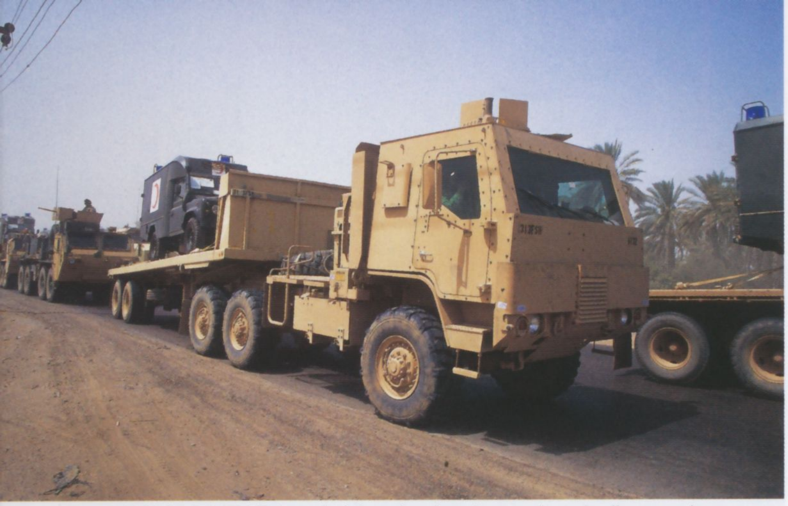
For obvious reasons, fuel tankers are extremely vulnerable to IED attacks. Therefore, the U.S. Army made some effort to protect them as well as possible. The M1088A1 MTV 5-ton 6x6 tractor truck of this fuel tanker has been fitted with an LSAC. In addition, the M969A2 Automotive Fuel Dispensing 5000-gallon Tank Semi-trailer has been fitted with the Tank Ballistic Protection System, plus the Fuel Tank Self Sealing System has been applied. The FTSS System is a coating permanently applied to the exterior surface of the fuel tank that will seal a leak caused by small-arms fire or shrapnel within 20 minutes of impact. A fuel tanker sealed like this can be continuously used on operations without limitation.



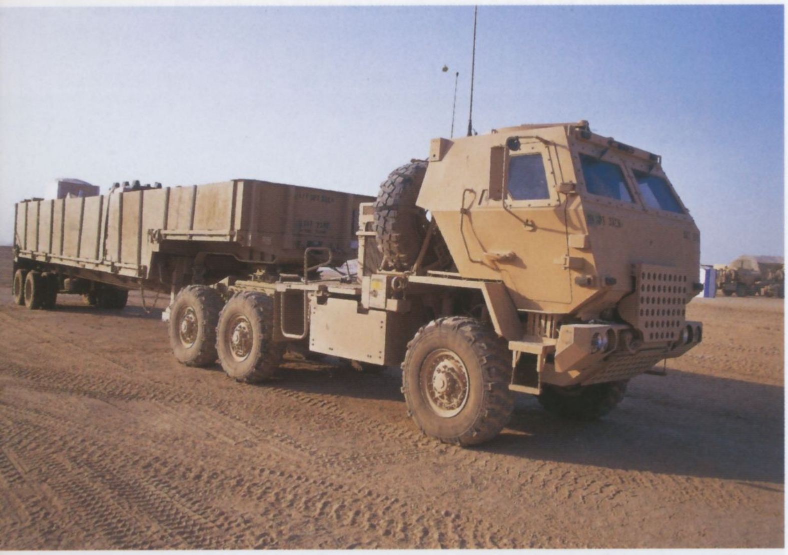
The pictured M1083 MTV 5-ton 6x6 drop-side cargo truck serving as a fuel truck has been loaded with a Tank and Pump Unit, Liquid Dispensing. It belongs to a unit of the Aviation Brigade of the 1st Cavalry Division, and was seen at Camp Taji in December 2004. It has been fitted with the RADIAN CPK.



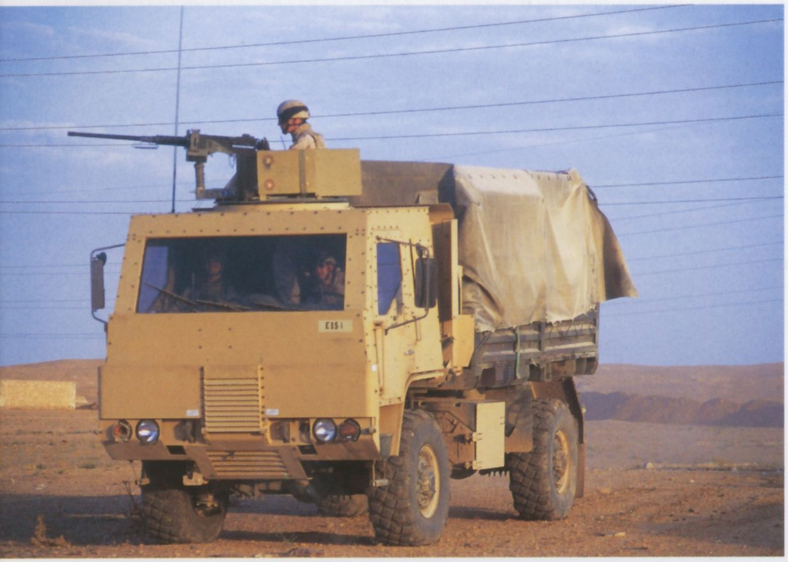
Rear view of an M1089A1 MTV 5-ton 6x6 wrecker fitted with an LSAC. The vehicle belongs to the Maintenance Troop of the Support Squadron "Muleskinner" of the 3rd Armored Cavalry Regiment, and was seen in Tall Afar in 2005. In view is the hydraulic under-lift system that has a lift capacity of 4990kg.



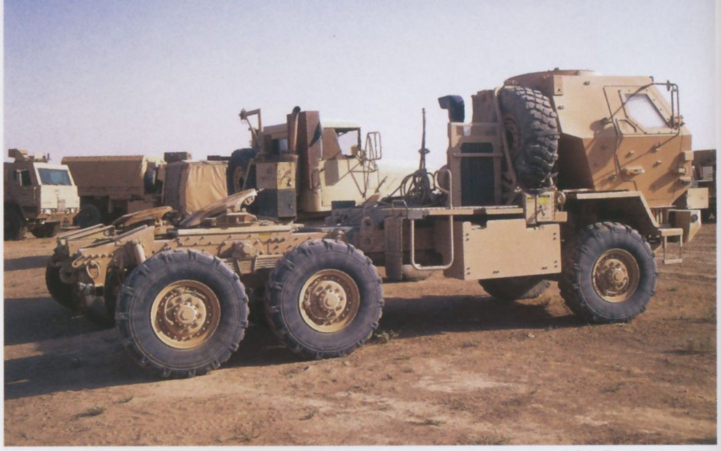
The M1088A1 MTV 5-ton 6x6 tractor truck can tow trailers up to a gross weight of 28,576kg. This example is pulling a semi-trailer loaded with Iraqi Army Land Rover ambulances. The vehicle belongs to the 3rd Forward Support Battalion and was seen on MSR Tampa south of Balad in July 2005. It is fitted with a CPK.



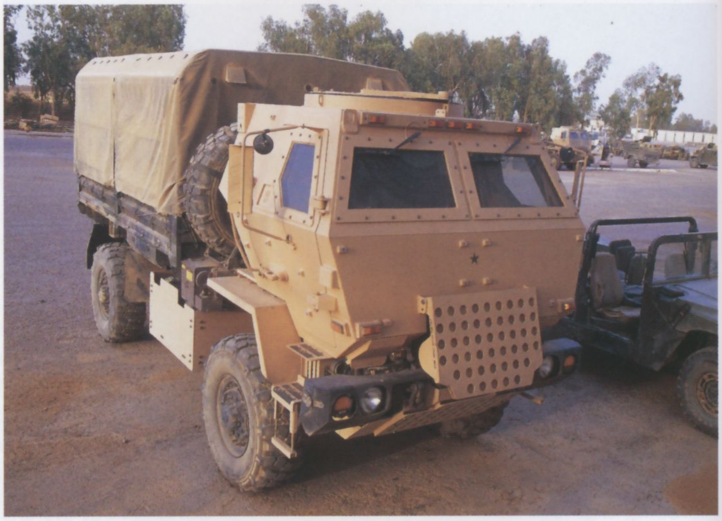
Here an M1088A1 MTV 5-ton 6x6 tractor truck can be seen pulling a semi-trailer in August 2005. The M1088A1 features a fully oscillating fifth wheel with a diameter of 914mm that accommodates a 51mm kingpin. The vehicle belongs to the 3rd Armored Cavalry Regiment.



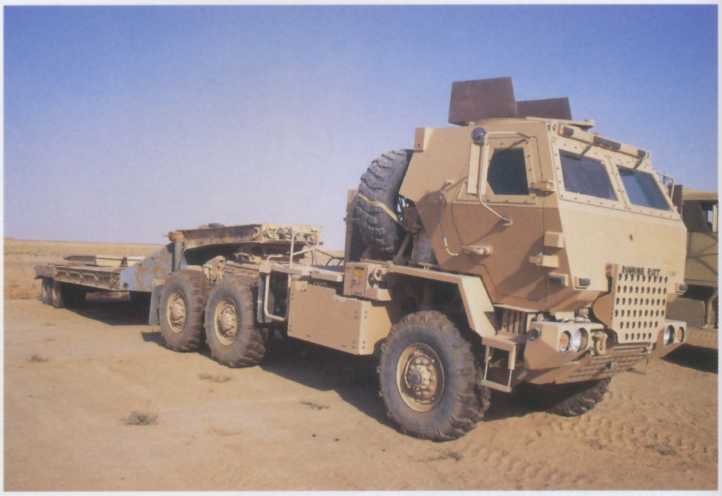
This M1078A1 LMTV 4x4 2.5-ton truck was seen conducting a patrol along the berm encircling Tall Afar. The vehicle belongs to Task Force D9 "Big Nasty" of the 507th Engineer Battalion, and was seen in August 2005. The vehicle is fitted with a CPK and a 12.7mm M2 heavy machinegun has been installed on the turret mount.



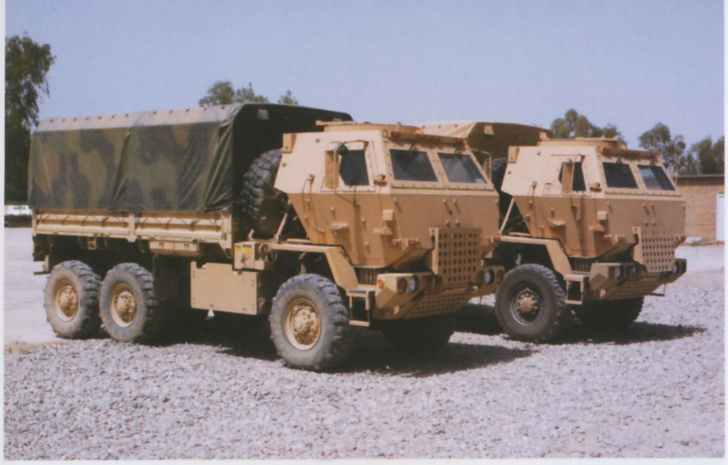
An M1088A1 MTV 5-ton tractor truck fitted with an LSAC. Note the armor plates protecting the vehicle's fuel tank. Like the RADIAN CPK, the LSAC contains parts that protect the crew as well as giving some protection for essential truck automotive parts.



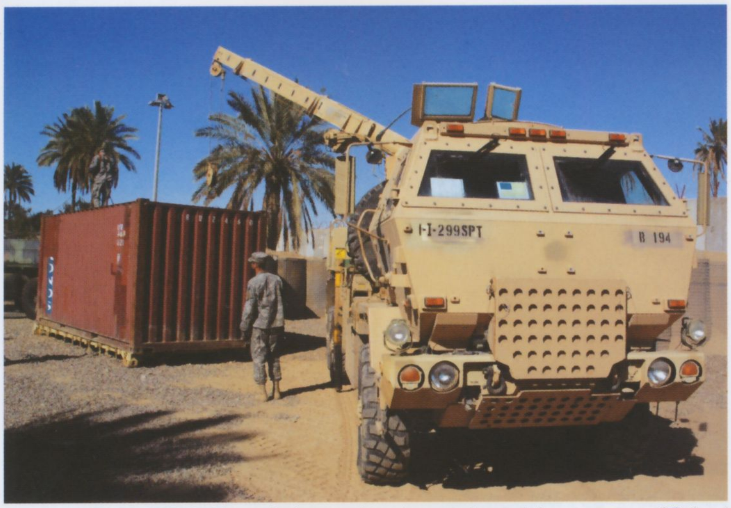
Here an LSAC has been mounted on an M1078A1 LMTV 2.5-ton 4x4 standard cargo truck. Originally the truck was painted in a standard NATO camouflage pattern. With the LSAC painted in tan, newly mounted parts can be distinguished clearly from original elements.



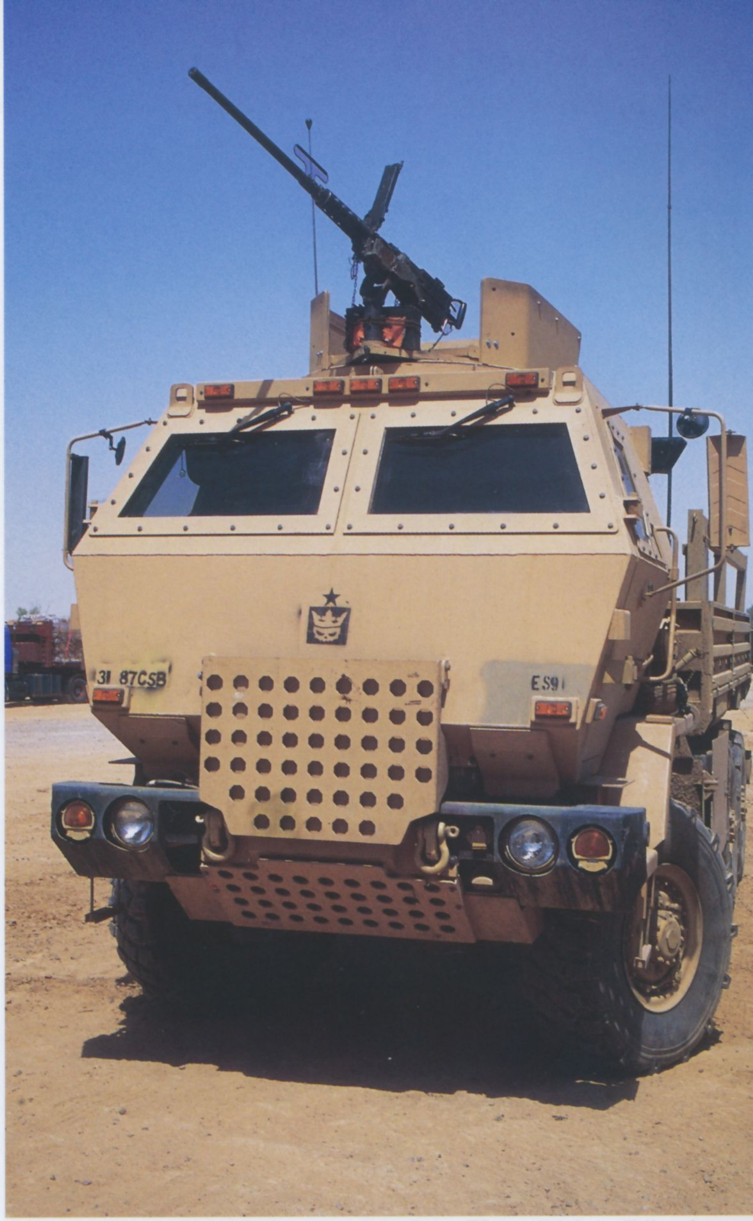
This picture shows another M1088A1 MTV 5-ton 6x6 tractor fitted with an LSAC. The LSAC weighs some 1500kg and is made from High Hardness Steel. It provides the crew with 360° protection from small-arms fire and blasts from mines, IEDs and artillery shells.



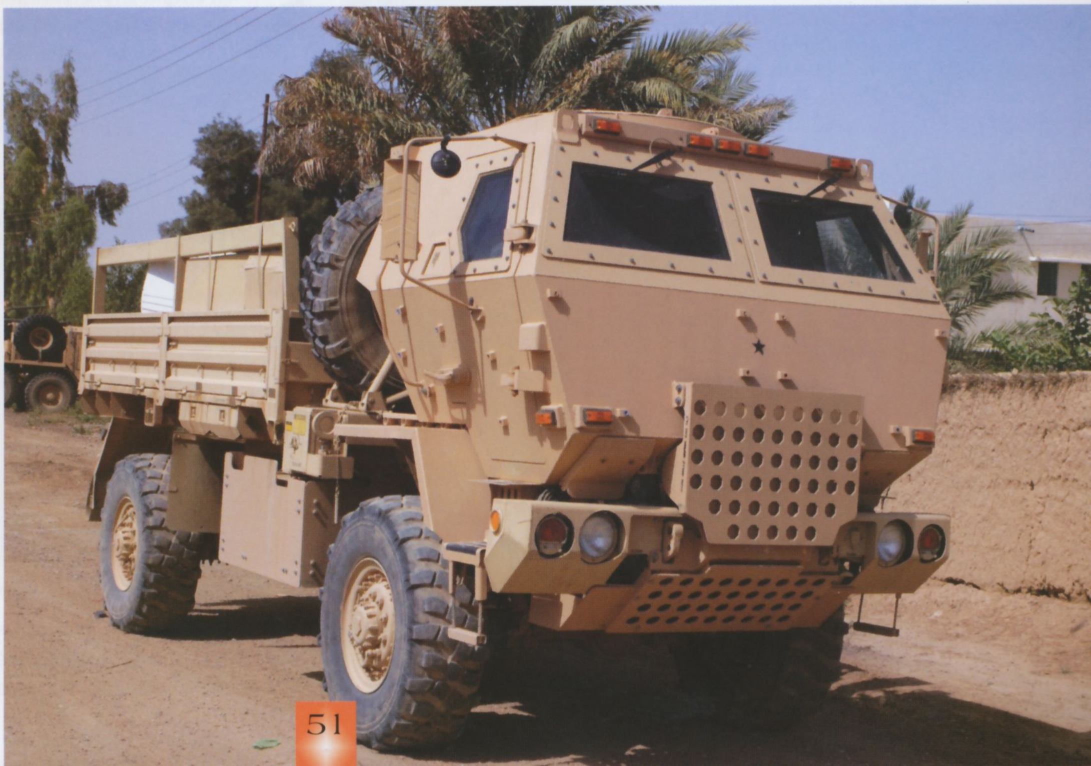
These two M1083A1 MTV 5-ton drop-side cargo trucks belong to the 1st Battalion, 68th Armor Regiment "Silver Lions", and were seen at Camp Gabe in mid-summer 2006. LSACs provide vehicle crews with protection from direct hits of 7.62mm armor-piercing ammunition, as well as IEDs with an explosive content of up to 8kg.



An M1089A1 MTV 5-ton 6x6 wrecker is employed to move a 20-foot container with its material handling crane. The crane can be rotated 270° and has a lift capacity of 4990kg at a boom extension of 2.1m. Its maximum boom extension is 5.5m. The pictured vehicle was seen at Camp Justice in Baghdad in March 2007. It belongs to the 299th Forward Support Battalion of the 1st Infantry Division, and features an LSAC

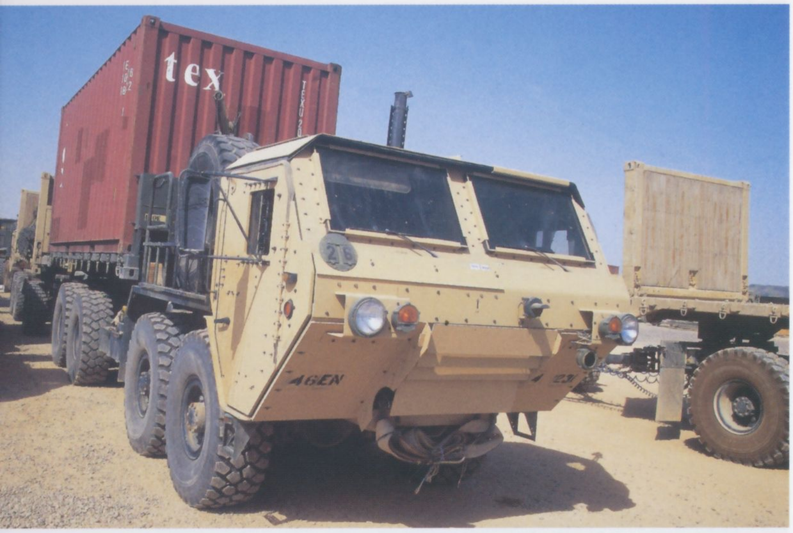


The windows of the LSAC are made from 75mm-thick ballistic glass and can withstand multiple hits by small-arms rounds or splinters. The shape of the LSAC deflects pressure from an IED blast. This vehicle belongs to the 87th Corps Support Battalion and was seen in 2005.

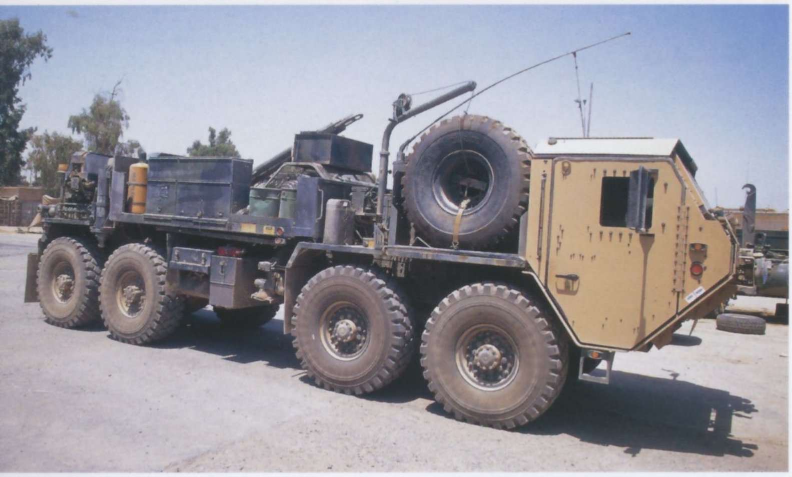


The LSAC gives FMTV trucks an aggressive look. Here the LSAC has been mounted on an M1078A1 MTV 2.5-ton drop-side cargo truck belonging to the 1st Battalion, 68th Armor Regiment. It was seen during a combat logistic patrol in the vicinity of Baqubah while supplying a remote outpost.

Heavy Expanded Mobility Tactical Truck



Most HEMTT family variants can be fitted with the CPK developed by Simula Incorporated. The CPK is mounted onto the original truck cab after some parts have been removed, and it adds 1,129.8kg to the original curb weight. Here a CPK can be seen mounted on an M1977 HEMTT Common Bridge Transporter (CBT) of the 46th Engineer Battalion. Note that the vehicle is being used as a cargo truck rather than in its original role.

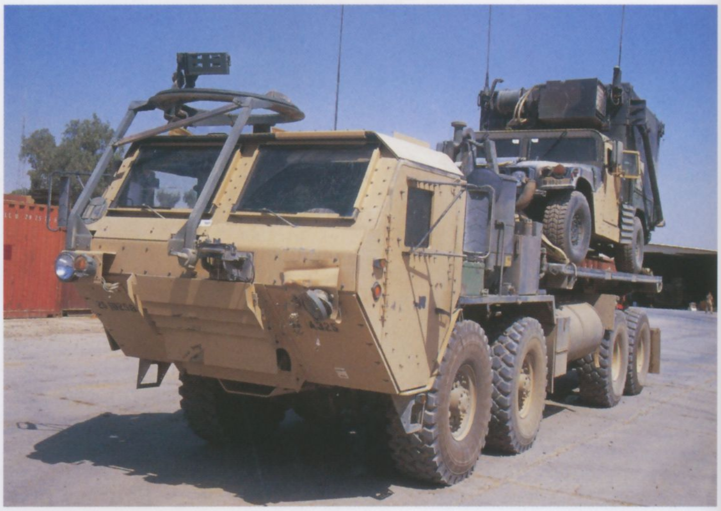


The recovery equipment of the M984A1 Truck, Recovery-Wrecker is mounted on the rear behind the engine compartment. It includes a Model 51022 60K two-speed automatic winch manufactured by dp-Manufacturing, with a line-pull capacity of 27,240kg, a hydraulic retrieval system used to lift the front axles of disabled vehicles during towing operations, and a Grove MHC984 telescopic crane with a maximum lift capacity of 2722kg at a boom extension of 5.5m. Extensive maintenance equipment includes oxygen welding gear, tow bars and towing scissors. The pictured vehicle belongs to the 25th Brigade Support Battalion and it was seen in Mosul in the summer of 2005.

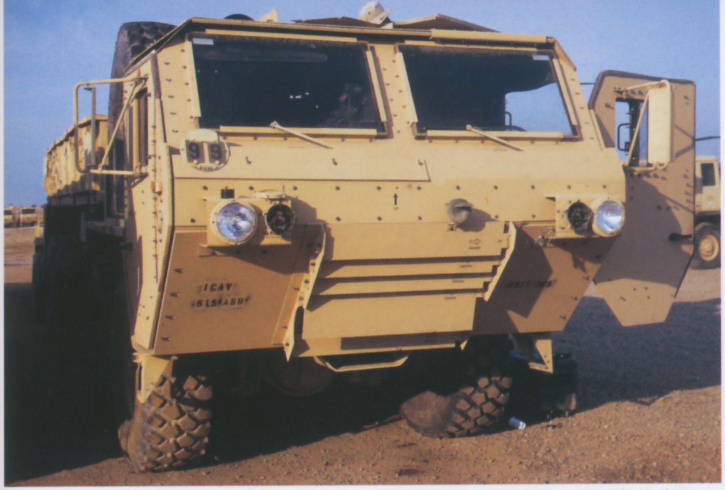
In the modern U.S. Army, vehicles of the Heavy Expanded Mobility Tactical Truck (HEMTT) fleet form the backbone of combat-arms logistic assets. These trucks operate in close proximity to fighting troops, supplying them with ammunition, fuel, food and other material. Special-purpose variants of the HEMTT family are used by nearly every unit that deploys into the field. Development of the HEMTT began in 1978 after the army identified a requirement for a new heavy-duty cargo truck. Several industry proposals were subsequently put through extensive troop trials under the High Mobility Tactical Truck Program, and finally the design offered by Oshkosh Truck Corporation was selected. The Oshkosh proposal not only fulfilled the requirements for load capacity and mobility in the field during the trials, but because it used commercial off-the-shelf technology, it promised low life-cycle costs. Series production of the HEMTT started in 1982, and some 13,000 HEMTTs in different variants had been manufactured for the U.S. Army up till 2006. In February 2007, the army ordered several hundred additional trucks. Originally the HEMTT family consisted of five different variants, but over the last 25 years, several new vehicles have entered service. In late 2007 the following major variants were in service with the U.S. Army:

M977 Truck, Cargo, with or without winch
M978 Truck, Tank, Fuel, with or without winch
M983 Truck Tractor, with winch, with or without crane
M984 Truck, Wrecker-Recovery
M984A1 Truck, Wrecker-Recovery
M985 Truck, Cargo, with or without winch
M985A1 Truck, Cargo, with or without winch
M1120 HEMTT Load Handling System (LHS), with or without winch
M1977 HEMTT Common Bridge Transporter (CBT) (transporter for the Standard Ribbon Bridge, Improved Ribbon Bridge, M18 Dry Support Bridge and Rapid Emplacement Bridge System)
M1142 Tactical Fire Fighting Truck

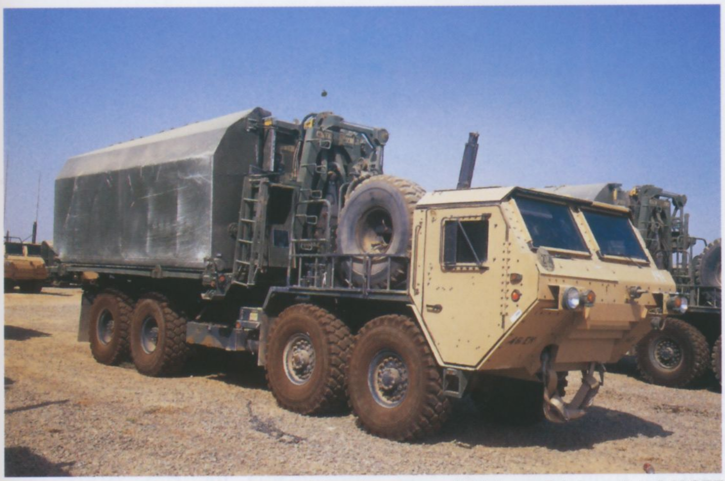
Over the years the army launched a couple of programs to maintain a high operational availability of its HEMTT fleet. From 1995 onwards, HEMTTs went through the Remanufacturing Program at Oshkosh Truck Corporation. After a total overhaul, vehicles were given back in an as-new condition and with a new factory warranty. These vehicles received an R1 suffix to their designation. In 2005 the Remanufacturing Program was transformed into the Recapitalization Program designed to modernize the HEMTT fleet. Vehicles modernized under this program were given the suffix A2R1. Among other modifications, A2 modernization includes CTIS, electronically controlled DDEC III version of the water-cooled Detroit Diesel 8V92TA V8 two-stroke turbocharged diesel engine, new



Here an M1120 HEMTT LHS truck loaded with an M3A1 Container Roll-in/Out Platform (CROP) can be seen. An M1113 HMMWV ECV in shelter-carrier configuration has been loaded onto the M3A1 CROP. Both vehicles are fitted with CPKs. The M1120 HEMTT LHS belongs to A Company of the 25th Brigade Support Battalion.



The M977 is the basic cargo truck. Without a CPK, the vehicle has a curb weight of 17,600kg and a payload of 10,523kg. The pictured vehicle belongs to the 615th Aviation Support Battalion of the 1st Cavalry Division, and was seen in Taji in December 2004. Visible is the Windshield Armor Protection Kit and Front Armor Protection Kit.



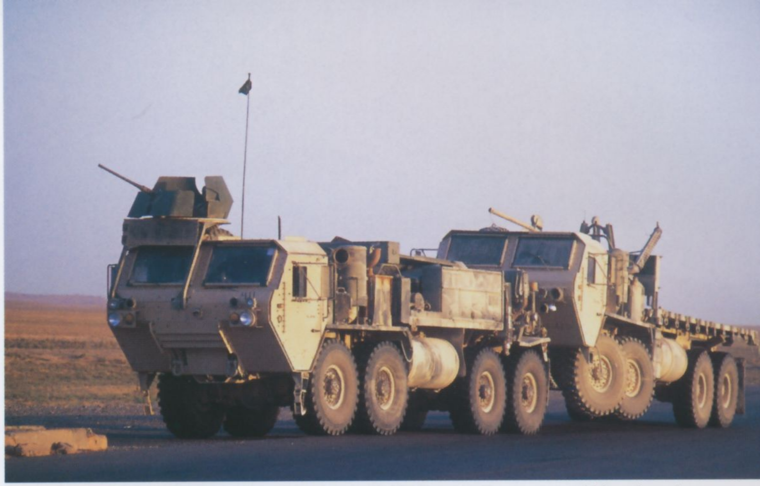
Loaded with an interior bay of the Improved Ribbon Bridge, this M1977 HEMTT CBT of the 46th Engineer Battalion was seen at LSA Anaconda in July 2005. With a CPK the vehicle has a weight of 25,830kg. The M1977 HEMTT CBT features a Multilift LHS that, in connection with the M15 Bridge Adapter Palette, allows the vehicle to drop bridge parts into rivers and lakes as well as to recover them.

electronically controlled Allison HD4560P/5 five-speed automatic transmission, new crew seats with air suspension, and two-part split-type wheel rims. Since 2005, new HEMTTs manufactured to this modernized standard were given just the A2 suffix in their nomenclature.

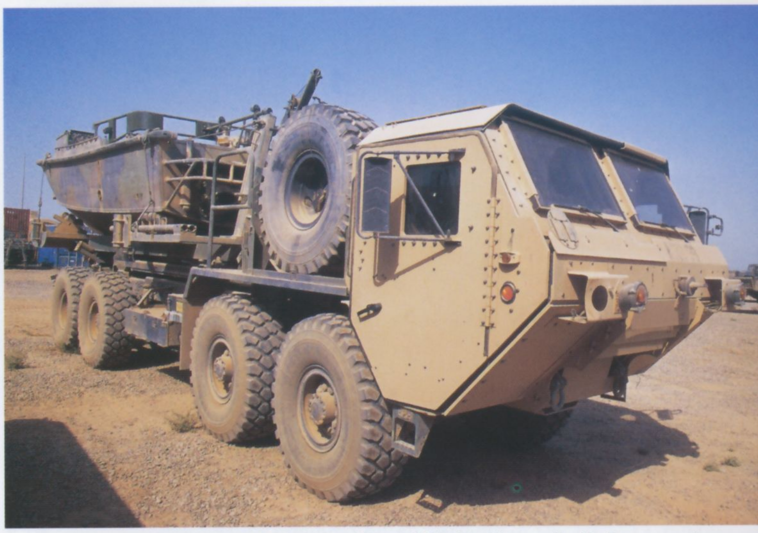
A little bit of HEMTT technology

The M1120 HEMTT LHS is a heavy forward-control tactical truck with 8x8 axle configuration designed for off-road use. The bolted box-section frame is built from formed channel segments made of heat-treated carbon manganese steel. The cab is made of corrosion-resistant, treated, welded steel plates. On the passenger side a circular hatch is located in the roof. Over the hatch an M66 machinegun ring mount can be installed, which can be fitted with a wide range of crew-served weapons such as 12.7mm M2 or 7.62mm M240B machineguns. The cab offers space for the driver and passenger who are seated in modern, suspended, ergonomically designed seats that feature three-point seatbelts. Controls for the Mk V Load Handling System are situated in the crew cab, in addition to standard driver controls. The two-part front windshield is made of safety glass.

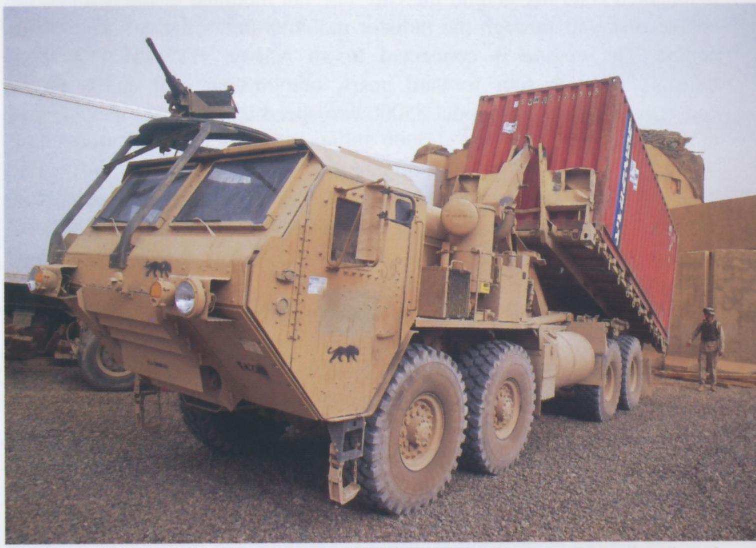
On the right fender behind the cab, the spare wheel is mounted alongside a light manual crane used to load and unload it. The engine air intake and hydraulic oil reservoir are situated behind the cab on the left fender. An extra-heavy skid plate stretches from the window frame down to the vehicle frame and serves as the front bumper. The water-cooled 8V92TA V8, two-stroke, turbocharged diesel engine with a displacement of 12.06 liters and power output of 445hp at 2100rpm, is manufactured by Detroit Diesel, and



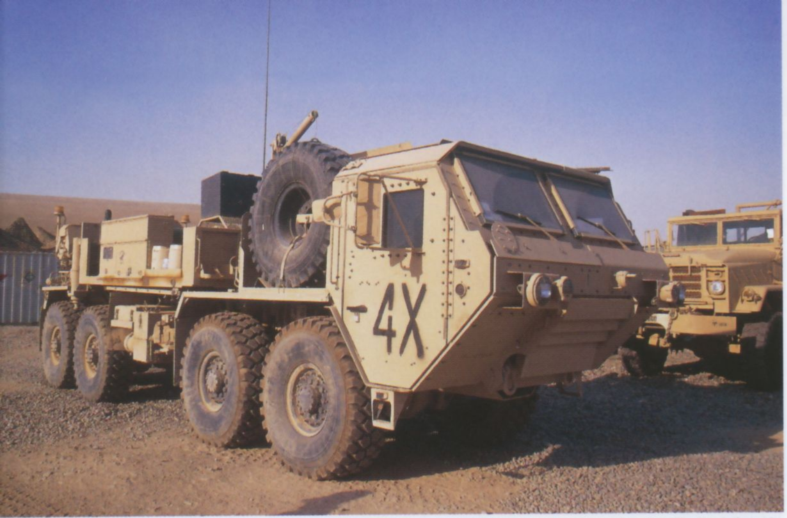
South of Tikrit in 2005, an M984A1 HEMTT Truck, Recovery-Wrecker, tows an M1120 HEMTT LHS. The M984A1 has lifted the two front axles of the M1120 by using its retrieval system with a lifting capacity of 11,340kg. Both trucks are fitted with CPKs. Note that the M984A1 has also been fitted with the gunner shield and circular turret armor of an ACAV Kit.



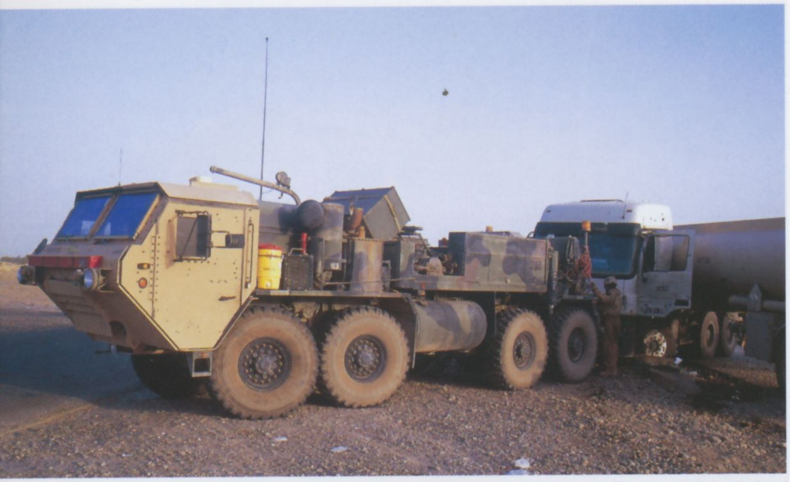
Here another M1977 HEMTT CBT of the 46th Engineer Battalion can be seen. The vehicle is being used to transport a Mk-2 S Bridge Erection Boat loaded on an M14 Improved Boat Cradle. With a CPK, this truck variant has a weight of 24,947kg, and is 8.204m long, 2.769m wide and 3.327m high. In July 2005, when this picture was taken, all M1977 HEMTT CBTs of the 46th Engineer Battalion had already been fitted with CPKs.



An M1120 HEMTT LHS drops an M1077A1 flat rack at a combat outpost in Samarra in July 2005. The vehicle belongs to F Company "Atlas", 3rd Battalion, 69th Armor Regiment. The Multilift Mk V LHS can lift flat racks with a load up to 9979kg. Here the M1077A1 flat rack carries a 20-foot ISO container. The M1120 is fitted with a CPK and M66 ring mount on which a 12.7mm M2 machinegun has been installed.



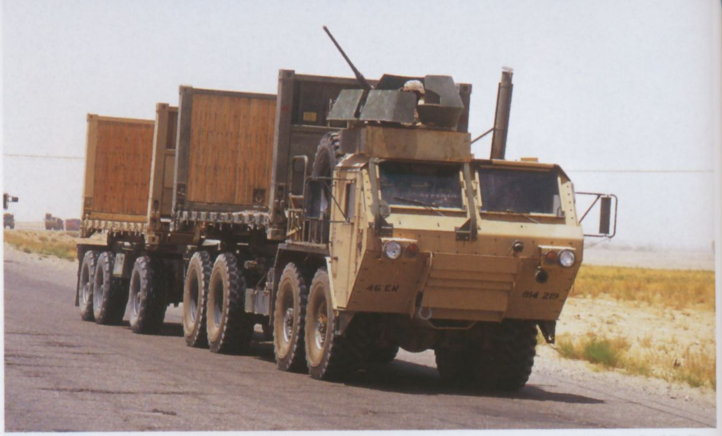
This M84A1 HEMTT Truck, Recovery-Wrecker, was seen in Tall Afar in August 2005. The vehicle belongs to the 3rd Armored Cavalry Regiment "Brave Rifles". The Louvered Grill Assembly of the CPK and headlight mountings are visible.



An M984A1 HEMTT Truck, Recovery-Wrecker, at work. The vehicle is just about to recover a damaged Mercedes ACTROS tractor truck and tanker semi-trailer hit by an IED south of Tikrit on 25 July 2005. The civilian driver and passenger were badly wounded by shrapnel that punctured the cab – a fate the crew of this M984A1 HEMTT would be spared in the event of a similar encounter, as their cab is protected by a CPK.

is mounted centrally behind the cab. The fan mounted at the front of the engine sucks air through the radiator mounted under the cab to cool the engine. The engine is connected to an Allison HT740D four-speed transmission with four forward gears, one reverse gear and a torque converter. An Oshkosh Model 55000 two-speed transfer case is connected to the transmission.

The two single-reduction Oshkosh 46K axles of the front tandem are steered. The dual-gear steering of the HEMTT is power assisted, and the steering gear is situated on the driver's side below the cab. Hydraulic pressure for the power steering, as well as for the vehicle's whole hydraulic system, is provided by a hydraulic pump situated on the left side above the engine. The rear DS-480 tandem axle is manufactured by Eaton and features a manually operated inter-axle differential. The 587-liter fuel tank is placed between the front and rear tandem axles on the left side. On the right side opposite the fuel tank is the battery box with four 12V 100A batteries connected in parallel. The electrical system of the HEMTT runs on 24V and electrical power is provided by a 65A alternator. The dual-circuit air-brake system works at an operational pressure of 60-120psi and features internal-shoe drum brakes. On the third and fourth axle, a spring brake serves as a parking brake. The RT340 suspension system consists of leaf springs with steel saddles and equalizing beams. HEMTT wheels consist of 20 x 10.00 steel rims and 16.00 R20 XZL Michelin tires. Standard equipment on all HEMTT variants includes blackout lights, slave start connector, external hydraulic connectors, manually operated pintle



Here an M1977 HEMTT CBT can be seen towing an M1076 PLST. The truck and trailer are loaded with M1 flat racks. In addition to the CPK, the vehicle has been fitted with parts of the ACAV Kit originally designed for the M113 in the Vietnam War. The pictured vehicle belongs to the 46th Engineer Battalion.

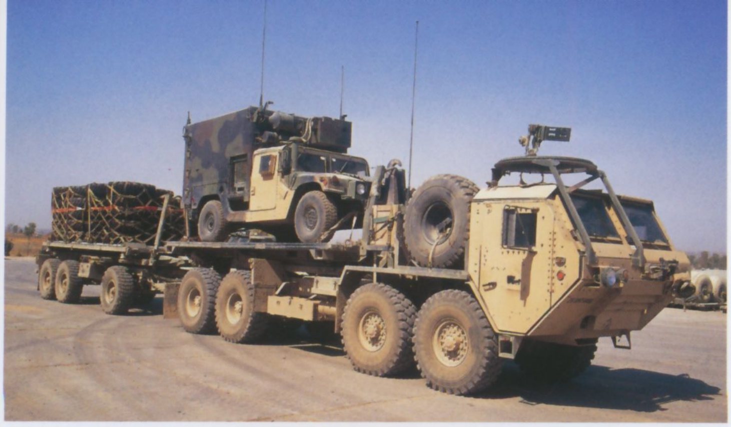
and connectors for trailer electricity and air brakes, air-pressure outlet with hose for refilling tires, NBC protection system (fitted optionally), and a pair of tow eyes at the front and rear on the vehicle frame. With the Mk V Load Handling System the M1120 HEMTT LHS can load and unload cargo flat racks without external help. Loading und unloading is done using the hook of the LHS. The hook grabs onto the hook bar of the flat rack, which is then lifted up at the front and pulled onto the back of the truck.

OIF deployment

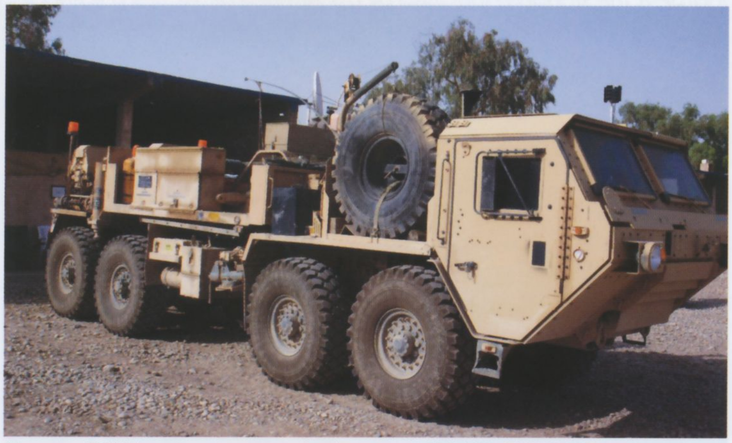
Since entering service in 1982, HEMTTs have taken part in nearly every operation conducted by the U.S. Army. In 1991 they served in Operation Desert Saber (the liberation of Kuwait), in Somalia in 1992-93 as part of Operation Restore Hope, since 1996 with IFOR and SFOR in Bosnia, since 1999 with KFOR in Kosovo, and from 2001 onwards in Operation Enduring Freedom in Afghanistan. It was during the Bosnia deployment that, for the first time, the army issued a requirement for a CPK for HEMTTs to protect crews from the mine threat that existed in Bosnia, as well as from small-arms fire. Subsequently the U.S. Army Tank Automotive Research, Development and Engineering Center developed an add-on armor kit, conducted blast tests with prototypes, and then further developed the add-on armor to series-production standard. Eventually Simula Incorporated was awarded a production contract for the CPK. The company states 186 CPKs were manufactured, but they were never used in Bosnia.

In 2003 a huge number of HEMTTs were deployed to Iraq, serving in the initial invasion and later with army units remaining in Iraq. By late 2003, some 1600 HEMTTs were still operating in Iraq. Like other trucks, they did not feature any kind of armor and were easy game for attackers when the insurgency kicked off. The requirement for add-on armor kits validated by the army numbered 1595 for HEMTTs, this later being raised to 2430 add-on armor kits. In a first step under the Vehicle Hardening Program, HEMTTs were fitted with Level III armor. These Level III armor kits involved add-on armor developed, manufactured and installed on vehicles by deployed troops. They were regarded as an interim solution as they could not provide the same protection level as industrially manufactured Level II armor kits, of which development started in late 2003. Level III armor did not feature windshields or side windows of ballistic-resistant glass, and therefore did not meet a 360° all-round protection requirement. Usually a Level III add-on armor kit consisted of steel sheets mounted on the brush-guard and skid plate, vehicle doors and machinegun mount.

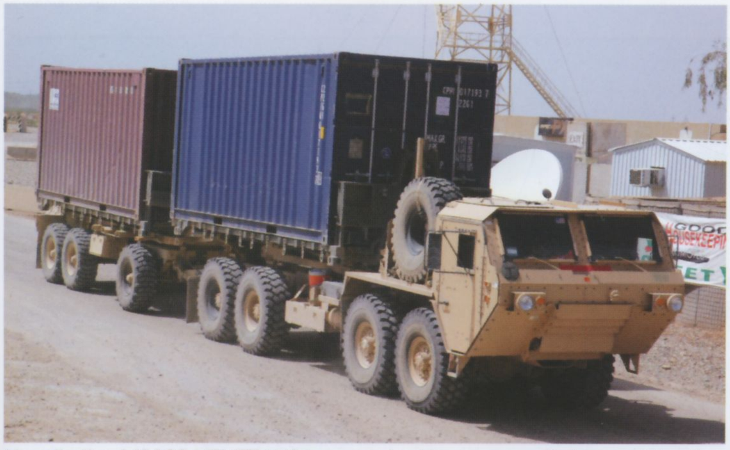
In addition to Level III add-on armor, Level II CPKs from the time of the Bosnia deployment were fetched from warehouses, shipped to Iraq and mounted onto HEMTTs. In addition to CPKs, vehicles were fitted with an air-conditioning unit. Simula Incorporated and the U.S. Army developed an upgraded Level II HEMTT CPK based on the one designed for Bosnia. In February 2004, only months after development started, Simula Incorporated was contracted to start series production of the new CPK. In the following months, up to 225 CPKs were manufactured per month. The



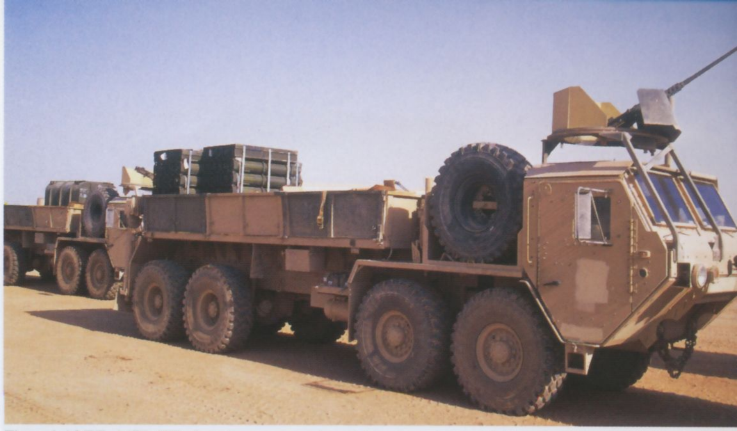
A view of an M1120 HEMTT LHS truck loaded with an M3A1 CROP. In addition to its M1113 HMMWV ECV load, the truck is pulling an M1076 PLST loaded with an M3A1 CROP with truck tires. An M66 ring mount has been fitted on the truck's CPK. This M1120 belongs to A Company of the 25th Brigade Support Battalion.



Here a CPK has been mounted on an M984A1 HEMTT Wrecker. When installing the CPK, the armored windshield frame (55.79kg) is mounted first, followed by windscreens made from ballistic glass (each window is 51.2kg). In the next step the left and right Front Side Armor Kits (14.06kg each) and door hinges are installed. Then the Front Armor Protection Kit is mounted (295.7kg), followed by the Rear Cab Armor Protection Kits (90.90kg combined). Next the armored doors, each weighing 152.29kg, are mounted and then the left and right rear side cab armor panels (12.25kg each) are installed. Next the blast deflectors are installed – driver's side blast deflector, passenger's side blast deflector, and center blast deflector (total of 198.72kg). Finally the Roof Armor Kit (75.30kg) and escape hatch (27.67kg) are mounted. Finally, parts of the original crew cab removed at the beginning (e.g. side mirrors, sidesteps, tow shackles, blackout lights, bridge weight sign and machinegun mount) are mounted onto the CPK.



Usually the M1120 HEMTT LHS is operated by army units in combination with the M1076 PLST trailer seen here. Such a combination can reach a gross weight of 46,720kg. In this case both trailer and truck are loaded with M1077A1 flat racks on which 20-foot ISO containers have been stowed. In view in this picture is the escape hatch of the CPK on the roof. The vehicle was seen in Camp Warhorse in May 2006.



The M977 HEMTT features a steel-base drop-side cargo bed that is 5.486m long. At the rear of the truck is an MHC977 telescopic material-handling crane. The Grove crane has a lift capacity of 1135kg at a boom extension of 5.8m, and the assembly includes two outrigger legs. The pictured M977 HEMTT belongs to the 3rd Armored Cavalry Regiment and is loaded with 155mm artillery shells. An M66 machinegun mount has been fitted to the CPK. Note the M2 machinegun and gunner shield of the ACAV Kit.

first HEMTTs in Iraq were fitted with the new CPK in April 2004, installed in specially established workshops, one of which was situated at LSA Anaconda near Balad. In these workshops, mixed teams of soldiers and civilian contractors worked 24 hours, seven days a week. By December 2004, 518 HEMTTs had already been fitted with new Level II CPKs and 2088 HEMTT CPKs had been fielded by September 2005. By 2007, all army HEMTTs deployed to Iraq and Afghanistan were fitted with CPKs. In November 2007, the HEMTT A4 went into production as part of the Long-Term Armor Strategy. Initially, the M1120A4, M978A4 and M977A4 were ordered by the army. The A4 features several improvements, the most important being a new Caterpillar C15 500hp diesel engine, Allison 4500SP five-speed automatic transmission and a common crew cab. In future, the common cab will be used on HEMTT and PLS trucks alike. It features built-in armor protection and has provisions for fitting an add-on armor package tailored to the mission by its crew.

HEMTT Crew Protection Kit

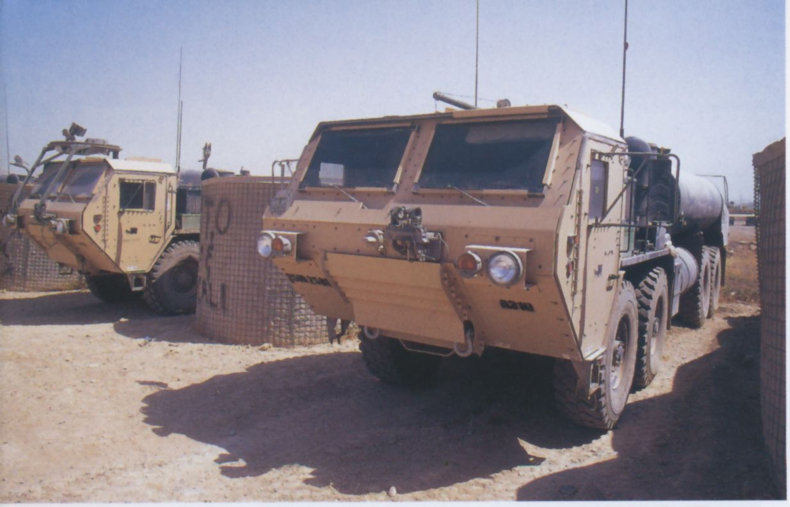
CPK add-on armor can be mounted on all variants of the HEMTT family currently fielded. It offers the crew ballistic protection from mines, IEDs and shrapnel from mortar and artillery rounds, as well as from small arms up to a caliber of 7.62mm. Before CPK add-on armor is mounted onto the cab of a HEMTT, the cab has to be partially disassembled. Some parts are replaced by new elements of the CPK. The suite consists of the following 12 components:

Underbody Protection Armor Kit
Installation Kit
Windshield Armor Protection Kit
Rear Cab Armor Protection Kit (2x)
Side Armor Kit (Left Hand) including door
Side Armor Kit (Right Hand) including door
Roof Armor Protection Kit
Front Armor Protection Kit
Fastener Kit Extra
Installation Instructions
C4ISR Mounting Hardware Kit including antenna mounts for PLGR and MTS

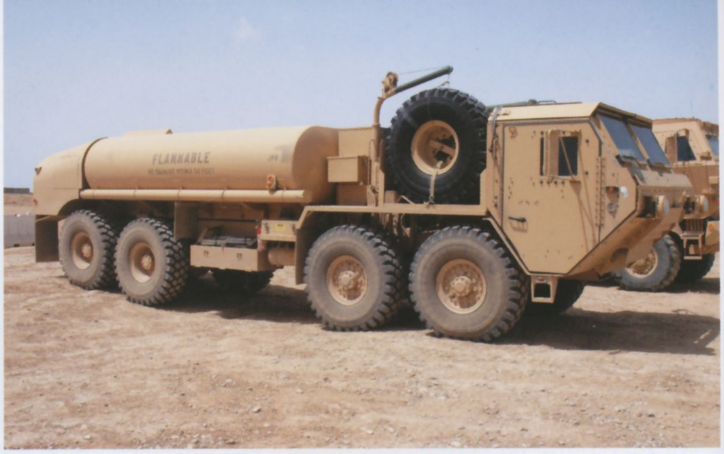
The complete CPK has a weight of 1308.16kg. After subtracting the weight of replaced parts, the result is a weight increase of 1129.8kg for HEMTT trucks fitted with the CPK.

Improved Crew Protection Kit

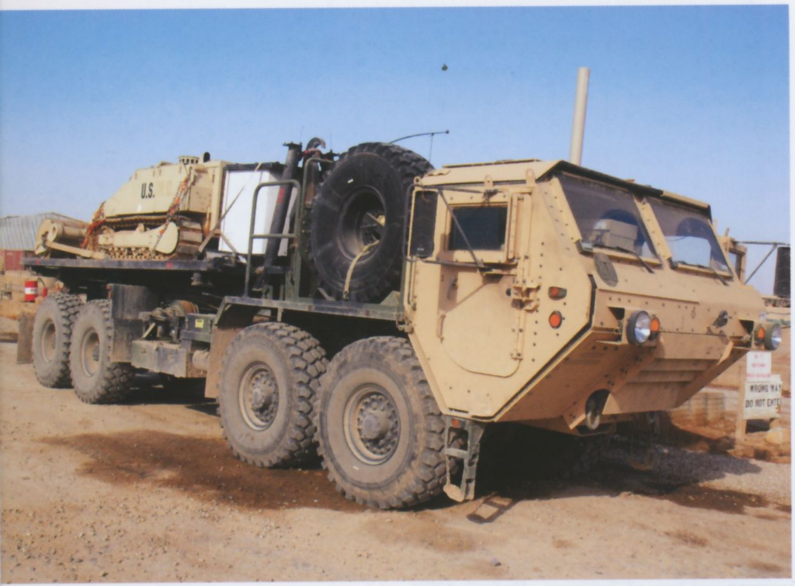
An improved version of the CPK, called CPK Model B, is also fielded by the U.S. Army. This kit features one-piece armor side panels for the cab, doors with modified windows, and a new opening mechanism for the windows. The CPK Model B is 300kg heavier than the original CPK. It offers flank protection for the crew. The larger side windows in the doors and their opening mechanisms have been moved to the outer side of the doors, allowing better side vision for the driver and passenger.



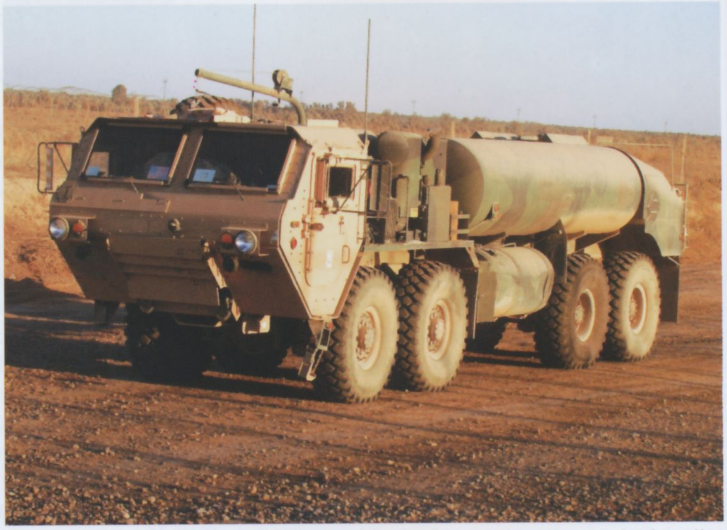
Well protected by rows of HESCO bastions, these M978 HEMTT tankers of A Company, 25th Brigade Support Battalion of the 1st SBCT, 25th Infantry Division, are parked at a base in Mosul in August 2005. Both vehicles are fitted with a CPK and feature a mount for the AN/VAS-5 Driver Vision Enhancer (DVE).



The M978 is the fuel tanker of the HEMTT family. In the welded stainless steel tank up to 9463 liters of JP-8, diesel, or other type of fuel can be transported. To the rear of the fuel tank, a fuel re-supply pump module is situated. Riding a fuel truck in Iraq is a scary job, taking into account that JP-8, the standard fuel used by U.S. Armed Forces, has a flashpoint of 37.8°C, when summer temperatures in Iraq reach well above 45°C!



This M1120 HEMTT LHS was seen at Camp Warhorse in January 2008. It is fitted with an improved version of the CPK, the Model B. This latest kit features reinforced one-piece side panels that each weigh 163.29kg and new doors weighing 161.93kg. The CPK Model B offers better side protection for the driver and passenger, with the side windows and their sliding mechanisms moved to the outside of the door. Note that the vehicle is fitted with a Warlock Electronic Counter-Measure (ECM) System.



The latest version of the CPK is the Model B, seen here mounted on the cab of an M978 Tanker at Camp Warhorse in January 2008. The side window of ballistic glass in the door is approximately double the size of the one on the earlier CPK variant. The larger window offers better vision for the driver.

Technical Data for M1120 HEMTT LHS

Crew:	2
Length:	9.982m
Width:	2.438m
Height:	3.759m
Curb weight:	16,556kg
Gross vehicle weight:	29,937kg
Engine:	Detroit Diesel 8V-92TA two-stroke V8 turbocharged diesel engine developing 445hp at 2100rpm
Transmission:	Allison HT740D 4- speed automatic transmission with four forward and one reverse gears
Maximum speed:	92km/h
Fording:	1.219m
Gradient:	60%
Side slope:	30%
Fuel tank capacity:	583 liters
Cruising range:	483km
Other systems:	CTIS, Multilift Mk V Load Handling System
Manufacturer:	Oshkosh Truck Corporation

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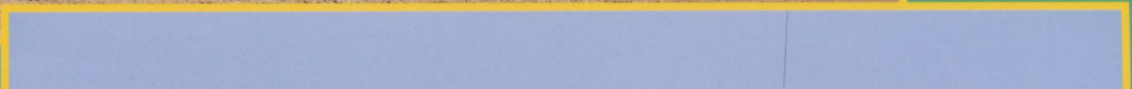
115FSB
162



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